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NOTICE TO EXCHANGES

The attention of learned societies and other institutions which exchange scientific publications with the University of Kansas is called to the list of publications of this University, on the third page of the cover of this issue.

Those marked "Supply exhausted" cannot be furnished at all; as far as the supply permits the remaining numbers will be furnished gladly to any of our exchanges who may need them to complete their files.

Back numbers of the *Kansas University Quarterly,* as far as possible, will be sent to those of our newer correspondents who are able and willing to reciprocate. Separates are available to specialists.

ANNOUNCEMENT

The *University of Kansas Science Bulletin* (continuation of the *Kansas University Quarterly*) is issued in parts at irregular intervals. Each volume contains from 300 to 400 pages of reading matter, with necessary illustrations. Exchanges with other institutions and learned societies everywhere are solicited. All *exchanges* should be addressed to:

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UNIVERSITY OF KANSAS

SCIENCE BULLETIN

A REVISION OF NEARCTIC DORILAIDAE (PIPUNCULIDAE)

BY

D. ELMO HARDY

Department of Entomology
University of Kansas, Lawrence, Kansas

VOLUME XXIX, PART I

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MAY 16 1949

Errata

For University of Kansas Science Bulletin, vol 29, pt. 1, no. 1, 1943. A Revision of Nearctic Dorilaidae by D. Elmo Hardy.

At the time the Dorilaidae revision was published, the author, Dr. D. Elmo Hardy, (Assistant Entomologist, University of Hawaii) was serving with the Army overseas and had no opportunity to correct the galley or page proofs. The following errors have been noted and should be corrected:

p. 15, line 37: read, Cercopidae, not "Ceropidae"

p. 24, line 35: read, Chalarinae, not "Charlarinae"

p. 25, line 22: read, Dorilinae, not "Dorilainae"

p. 26, line 15: read, appendice, not "appendics"; line 16: read, articulo tertio inferne; line 19: read, mik for "mic"; line 32: read mik for "mic"

p. 27, line 3: read, mik for "mic"; line 17: *Cephalops aucta* Fallen reference should be corrected to read 1817, Dipt. Suec., Syrphici: 61, instead of 1899 Wien etc.

p. 40, line 34: insert the name *Strandimyza* Duda, 1940, Folia Zool. et Hydrobiol., 10: 216 as a synonym of *Cephalosphaera* Enderlein.

p. 54, line 31: read, *Dorilas* Meigen, not "Meigan"

p. 57, line 22: read, *ater* Meigen, not "Meigne"; line 49: read, 24b, not "24a"

p. 62, line 41: delete p. at end of line

p. 123, line 25: read, antennae (not "occiput") entirely yellow

p. 147, line 57: read, *lepidipes* (not *longipes*) n. sp., p. 166 (not p. 147)

As was pointed out by Dr. M. T. James, (1944, Proc Ento. Soc. Wash., 46.) harpago not "harpagone," is the correct singular of the word harpagones. The term used to designate the singular in this paper is incorrect.

THE UNIVERSITY OF KANSAS
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VOL. XXIX, pt. I] JULY 15, 1943 [No. 1

A Revision of Nearctic DORILAIDAE (PIPUNCULIDAE)*

D. ELMO HARDY

ABSTRACT: A monographic study of all of the known Nearctic species of the Dipterous family DORILAIDAE, bringing up to date the taxonomy and known data concerning these flies. Containing keys to the subfamilies, genera and subgenera of the world and keys to the species of Nearctic genera, with eighteen plates and 464 figures illustrating the important taxonomic and morphological characters. Fourteen world genera and one subgenus are described; one genus is described as new; one hundred and seventeen species, subspecies and varieties are discussed, twenty-seven are described as new. The new genus, species, nomenclatorial changes, new synonymy and combinations are as follows: New genus: *Allomethus* (genotype *Allomethus brimleyi* n. sp.) New species: *Chalarus latifrons; Cephalosphaera maxima, tibialis; Dorilas aquavicinus, bidactylus, cinctus subtilis* n. sub. sp., *curtus, grandis, huachucanus, lautus, montivagus, nevadaensis, sabroskyi, stainsi; Dorylomorpha canadensis, ornata, tridentata, uncinata; Tömösváryella brevijuncta, dissimilis, exilidens, lepidipes, pauca, propinqua, quadradentis* and *xerophila*. Nomenclatorial changes: *Dorilas* used instead of emended spelling *Dorylas; Eudorylas* Aczel made subgenus of *Dorilas*. New synonymy: *Prothechus* Rondani (*Verrallia* Mik is an isogenotypic synonym); *Prothechus auctus* (Fallen) (= *Verrallia virginica* Banks); *Cephalosphaera brevis* (Cresson) (= *Pipunculus eronis* Curran); *Dorilas affinis* (Cresson) (= *Pipunculus globosus* Cresson; *D. fuscus* (Loew) (= *P. cingulatus* Cresson); *D. fuscus* var. *nitidiventris* (Loew) (= *P. sororius* Cresson and *viduus* Cresson); *D. loewii* (Kertesz) (= *P. semifasciatus* Cresson and *P. nigricornis* Adams); *D. nigripes* (Loew) (= *P. dubius* Cresson and *P. winnemannae* Malloch); *D. subopacus* (Loew) (= *P. confraternus* Banks and *P. occidentalis* Malloch); *D. subopacus industrius* (Knab) (= *P. confraternus* var. *melanis* (Hardy-Knowlton); *Tömösváryella subvirescens* (Loew) (= *P. pilosiventris* Becker, *albiseta* Cresson, *insularis* Cresson, *metallescens* Malloch and *knowltoni* Hardy); *T. vagabunda* (Knab) (= *P. trochanteratus* var. *tenellus* Hardy-Knowlton). New combinations: *Prothechus auctus* (Fallen), *csikii* (Aczel); *Jassidophaga fasciata* (Hardy), *pilosa* (Zetterstedt); *Cephalosphaera acuminata* (Cresson), *appendiculata* (Cresson); *biscaynei* (Cresson), *brevis* (Cresson), *constricta* (Banks), *elegantula* (Williston), *stricklandi* (Curran); *Dorilas abberatus* (Hardy-Knowlton), *acquus* (Cresson),

* Part I of the thesis submitted to the Department of Entomology and the faculty of the Graduate School of the University of Kansas in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

aequus var. *argryofrons* (Hardy-Knowlton), *acquus* var. *longipes* (Hardy-Knowlton), *affinis* (Cresson), *alpinus* (Cresson), *alternatus* (Cresson), *angus* (Cresson), *apicalis* (Hardy-Knowlton), *ater* var. *velutinus* (Cresson), *atlanticus* (Hough), *banksi* (Aczel), *caudatus* (Cresson), *caudatus* var. *discolor* (Banks), *cinctus* (Banks), *flavitarsis* (Williston), *fuscitarsis* (Adams), *fuscus* (Loew), *fuscus* var. *nitidiventris* (Loew), *harmstoni* (Hardy-Knowlton), *houghii* (Kertesz), *houghii apicarinus* (Hardy-Knowlton), *houghii curvitibiae* (Hardy), *lasiofemoratus* (Hardy-Knowlton), *latipennis* (Banks), *loewii* (Kertesz), *luteicornis* (Cresson), *minor* (Cresson), *minor cressoni* (Johnson), *nigripes* (Loew), *pallipes* (Johnson), *reipublicae* (Walker), *stigmaticus* (Malloch), *stigmaticus brachystigmaticus* (Hardy-Knowlton), *subopacus* (Loew), *subopacus industrius* (Knab), *tarsalis* (Banks), *trichaetus* (Malloch), *varius* (Cresson), *varius* var. *mainensis* (Cresson), *varius* var. *phaethus* (Hardy-Knowlton) *vierecki* (Malloch), *willistoni* (Kertesz); *Allomethus flavicornis* (Williston), *xanthopodus* (Williston); *Dorylomorpha atramontensis* (Banks), *caudelli* (Malloch), *exilis* (Malloch), *flavomaculata* (Hough), *occidens* (Hardy); *Tömösváryella appendipes* (Cresson), *bidens* (Cresson) *columbiana* (Kertesz), *contorta* (Hardy), *coquilletti* var. *flaviantenna* (Hardy-Knowlton), *inconspicua* (Malloch), *sachtlebeni* (Aczel), *similis* (Hough), *sonorensis* (Cole), *subnitens* (Cresson), *subvirescens* (Loew), *toxodentis* (Hardy-Knowlton), *utahensis* (Hardy-Knowlton), *vagabunda* (Knab) and *wilburi* (Hardy).

INTRODUCTION

THE writer first became interested in the DORILAIDAE (PIPUNCULIDAE) several years ago while studying under Doctor V. M. Tanner at Brigham Young University. At that time little or no success was to be had in making identifications of local material; only a few of the species could be placed in Cresson's Key[1] and the group had to be put aside unfinished. Later while at the Utah Agricultural Experiment Station the economic importance of these flies was brought vividly to the attention of the writer in the work on beet leafhoppers, under Doctor G. F. Knowlton, and part of his assignment was to make a more complete study of these important parasites. After summarizing the literature in this field it was found that there was little information concerning the western species and that a good many of them were apparently undescribed. This revisional study of the family has been in progress during the past three years at the University of Kansas, where now exists (in the Snow Entomological Collection) the largest, most complete collection of DORILAIDAE in America. All of the available types of North American species were examined[2] before this study was completed.

1. 1911, Trans. Amer. Ento. Soc. XXXVI.
2. Made possible by a traveling grant graciously given by Doctor H. B. Hungerford.

Cresson's commendable paper in 1911 "Studies in North American Dipterology" was the last comprehensive survey of this family. Since that work the number of species and subspecies has been more than doubled and innumerable taxonomic changes have been made, so that the earlier revisions have become archaic. A great many problems have been encountered and no doubt there are still many to be straightened out before systematic stability can be reached in this family. Cresson's study has stimulated considerable interest in the taxonomy of these flies in America and many valuable contributions have been made to the literature since its publication, yet in spite of the attention they have received there is comparatively little information concerning their life histories and host relationships. They are known to be largely parasitic upon leafhoppers but only meager data have been compiled as to the exact leafhopper species involved, the degree of host specificity and their importance in biological control of injurious species. This family embodies a wealth of interesting and important biological problems and since there is rapidly becoming an intense need for data concerning their life histories much valuable work remains to be done along this line.

The DORILAIDAE have been considered by some observers as the most adept and graceful fliers in the DIPTERA; due to their inconspicuousness and small size, however, it is somewhat difficult to verify this but if one has the perseverance to search them out with his eye as they fly through the vegetation he will see that they well deserve their close relationship to the SYRPHIDAE. The writer has found that in making observations of their flight it is best to sight through the grass against the sun until the glint of the wings of one is seen, then its undulating motions can readily be followed. The iridescence of their wings in the sunlight makes an easy target to follow but as soon as a shadow falls across the performer it disappears from sight, to be revealed again as soon as a ray of light catches its wings. It is a most fascinating sight to watch one of these tiny creatures flying irregularly through the tall grass, reminding one of a hawk soaring in and out through the trees of a dense forest, and, like the hawk, they too are searching for prey. The female appears to be the more erratic flier as she darts to and fro in the herbage, apparently examining every blade of grass in her search for suitable Homoptera nymphs; while the male, not being intent upon such an errand, flies in a more definite course. The enormous compound eyes which cover the entire head no doubt serve to give them the sharp vision which they would need to fit

into their particular niche in the world of parasites and episites. The patient observer in a grassy meadow may often see a female suddenly pounce down upon a selected individual, grasp it in her legs and insert her slender ovipositor in the conjunctiva between the sclerites of the abdomen; the well developed pulvilli and tarsal claws aid her in holding the host. The actual oviposition process is very difficult to observe because of the rapidity of the action involved. Two methods of oviposition have been recorded: Doctor F. X. Williams in his work on parasites of *Perkinsiella sacharricida* [3] made the following observation:

"The victims selected are very small to perhaps a little less than half-grown leafhoppers. A suitable one being discovered by the hovering fly is suddenly pounced upon and snatched up into the air. The captive is sometimes dropped almost immediately as if unsuitable, others, however, are held in mid-air for from one to several seconds, the fly usually rising a little with her burden which would be dropped on a leaf or on the ground. Often immediately thereafter, Pipunculus would hunt out another hopper, showing that she must have several eggs ready for laying."

He also observed that the newly parasitized leafhoppers were apparently uninjured and would soon find their way back to the protection of their host plant. Doctor F. Jenkinson recorded the following observation of the oviposition of *Prothechus auctus* (Fall.) (*Verrallia*) in England: [4]

"As soon as a Verrallia saw a frog-hopper it poised itself in the air (like a Kestral hovering, but with a certain intensity perceptible in its motionlessness), and if the position of its victim was favorable, it pounced upon it immediately. Then the frog-hopper hopped; in some cases the fly lost it; in some cases the fly reappeared instantly from the place to which the frog-hopper hopped. In one case I saw the frog-hopper land with the fly still on its back. . . . If the position was unfavorable, or stems got in the way (e. g. *Geranium robertianum*), the fly would circle round with its head towards the victim, like a male Dolichopus, seeking a point from which to pounce. On several occasions it failed to get hold. Once a fly pounced upon a frog-hopper which did not hop; the fly immediately left it. Another came up and looked at it, but went away without touching it. Was the frog-hopper already entertaining an egg, or was it a male, or for some reason unsuitable?"

TAXONOMY

In phylogenic position the DORILAIDAE stand between the PLATYPEZIDAE and SYRPHIDAE. They possess many characters in common with both of these but differ strikingly in biology and structural details. The DORILAIDAE are entirely parasitic in the larval stage while the larvae of the other families are predators or scavengers.

3. 1919, Some Observations of Pipunculus Flies which Parasitize the Cane Leafhopper at Pahalo Hawaii. Proc. Haw. Ent. Soc. IV, No. I; 68-71.

4. 1903, Ent. Monthly Mag., XXXIX; 222.

The characters of the wing venation will best serve to separate these families, but once examples of each have been seen there can be no mistaking one for the other except in a few instances. Most of the DORILAIDAE lack the striking colors of the SYRPHIDAE and are much smaller in size; however, *Nephrocerus* and *Protonephrocerus* are of considerable size and light in color, looking superficially like many of the SYRPHIDAE, especially of the genera *Sphaerophoria* and *Allograpta*. The male genitalia of DORILAIDAE and SYRPHIDAE show close relationship, the posterior portion of the abdomen being distinctly asymmetrical with the hypopygium twisted ventrally; the females of the two families possess very different genital structures, those of DORILAIDAE being modified for piercing the body of the host.

The name *Dorilas* Meigen is adopted here in preference to *Pipunculus* Latreille in spite of the recognized controversy that this procedure will cause. Opinion No. 28 of the Rules of Zoölogical Nomenclature states, "The generic names contained in Meigen's Nouvelle Classification, 1800, must take precedence over those in his Versuch 1803, in every case where the former are found valid under the International Code." In Meigen's description of *Dorilas* he makes the statement "Tete hemispherique"; this would suggest one of the genera which actually possesses a hemispherical head and not *Dorilas;* making it questionable whether or not he had *Dorilas*, *Jassidophaga* or *Prothechus* before him. Because of this doubt the writer has previously preferred to retain *Pipunculus* until further proof was obtained. In correspondence with Professor Pius Sack it was learned that Theodore Becker has studied the Meigen types in Paris and designated Latreille's *Pipunculus* as being congeneric with Meigen's *Dorilas*. As Becker was the leading worker in the group at that time there is no possibility for a misidentification on his part. It has been argued by some that Meigen had not intended for this earlier paper to be used, that it was just an experiment on his part, nevertheless, it was published and unfortunately was brought to the attention of the scientific world in 1908 by Hendel.[5] Meanwhile before the paper was discovered Meigen's 1803 genera and the early names of other workers were being established in the literature, so that when it appeared necessary to change to the older names usage stepped in to play a decisive part in the opinions of the majority of the workers. Whether or not usage should have preference over priority is debatable but unless the commission rules these

5. 1908, Verh. K. K. E. B. Gesll. in Wien. LVIII; 43-69.

names *nomen conservandum* the only alternative is to abide by the opinion given in the rules. At present it appears that this is a step toward taxonomic stability and it is realized that use of either name would bring criticism from one source or another as the question is so controversial. It so happens, however, that most of the American dipterists are in favor of using the 1803 names, while for the most part the continental European workers have changed to the 1800 names. These are used in Lindner's "Die Fliegen der Palaerktischen Region."

The following is Opinion No. 7 rendered by the Committee on Nomenclature, Division of Insect Identification, Bureau of Entomology and Plant Quarantine, Washington, D. C.:

"Concerning the family names Dorilaidae and Pipunculidae:

"Mr. D. Elmo Hardy has requested an opinion on the use of the family name DORYLAIDE in place of the family name PIPUNCULIDAE, in the order DIPTERA.

"OPINION. On the basis of the evidence presented, and in accordance with article 5 of the International Rules of Zoölogical Nomenclature, it is necessary to adopt the name Dorilaide in place of the name Pipunculidae.

"DISCUSSION. Latreille, in 1802 (Histoire Naturelle, generale et particuliere des Crustaces et des Insectes, Vol. 3, p. 463), described the genus *Pipunculus* with *campestris* Latr. as the type. Meigen, in 1800 (Nouvelle classification des mouches a deux ailes, p. 31), described the genus *Dorilas* with one unnamed species. Coquillett, in 1910 (The type-species of the North American genera of Diptera, p. 535), designated *Pipunculus campestris* Latr. as the type of the genus *Dorilas* Mg. Two genera thereby became isogenotypic, with *Dorilas* having priority. Article 5 states that, "The name of a family or subfamily is to be changed when the name of its type genus is changed." There seems no alternative but to change the family name in this case.

"No reason is apparent for accepting the amended spelling *Dorylas,* first proposed by Kertesz in 1910, so the family name should be Dorilaidae. Kertesz 1910 and Sack 1935 used the family name Dorylaidae.

"Opinion written by Alan Stone and concurred in by P. W. Oman, H. S. Barber, and C. F. W. Muesebeck. October 23, 1940."

The term *subspecies* is used in this paper to designate those groups of variants within a species which appear to be restricted in their geographical distribution; *variety* is used for variants from the typical which occupy the same geographical range.

The recent studies by Enderlein, Aczel and Collin have resulted in the erection of nine new genera of DORILAIDAE and have introduced rather radical changes in the generic concepts in this family. These genera are for the most part based upon previous subgeneric characters and the groupings are not as clear cut as the old limitations and may be subject to some intergradation. There is no doubt

that this represents progression in the DORILAIDAE taxonomy, and as new characters are brought to light and new importances given to the old characters other groupings will no doubt be erected which will further subdivide the family.

The DORILAIDAE have generally been considered rather difficult to classify, but this certainly need not be the case, as their diagnostic characters are for the most part well defined. The main stumbling block has been in the jumbled taxonomic status of the group, and in many cases the varying specific concepts or lack of stress upon important characters. As these flies are comparatively rare in collections, and the sexes are so often unassociated, many species have been described from one sex, frequently a unique, the opposite sex sometimes being described as a distinct species. Still other species have been based upon variable characters which in the light of the thousands of specimens studied do not appear to be specific. The conclusions here are based upon studies of all the available specimens in the family. Much valuable information is to be gained and many problems yet to be solved by extensive systematic collecting and life history studies of these important flies.

Geographical distribution is not so important in this group as might be thought; many specimens have been described as new on nothing more than the fact that the examples were taken from some locality remote from the type of the species; the *Tömösváryella subvirescens* synonymy illustrates this. At present the seemingly queer distribution of many species is not understood: *e. g.*, why *Dorilas alpinus*, described from Vermont, should next appear in the mountains of Utah, or why *Tömösváryella coquilletti* should recently show up in Hungary. Knowledge of host requirements and distributional studies of suitable hosts may solve these problems.

MORPHOLOGY AND TERMINOLOGY

The head is large and composed almost entirely of compound eyes. The shape varies from hemispherical, in *Chalarus* to almost spherical in the higher genera, being for the most part generically distinctive. The hind margin of the eyes is strongly indented in members of the Nephrocerinae and almost straight in genera such as *Dorilas* and *Tömösváryella*. The head shape is greatly influenced by the size of the occiput, which is extremely narrow, almost completely hidden by the hind margin of the compound eyes in *Chalarus* and is very broad and puffed in females of *Cephalosphaera appendiculata* (Cresson), being intermediate between these extremes in other genera and species. The eyes of the males are

contiguous for at least a short distance on the front except in the *Chalarus*, NEPHROCERINAE, *Dorylomorpha* and some *Dorilas*. Those of the females are dichoptic, the front usually being slightly wider in the middle than at the antennae. The front varies from gently concave to convex longitudinally down the middle, from densely to thinly pollinose and from opaque to polished. The eyes are bare and the face and front have only microscopic pubescence with no strong bristles on head (exclusive of antennae) except in CHALARINAE. The antennae are composed of three segments, the first is small and obscure, seldom seen in ordinary microscopic observations. The second segment is many times wider than the first, in a few species almost equals the third and ordinarily is scarcely over one third the size of the large apical segment. It usually has short to elongate bristles above and below and the apex is narrowed below and fits up into an angulation of the third segment. The third segment assumes a great many shapes from almost oval through reniform to very long acuminate. For the most part the reniform type is restricted to the primitive genera in CHALARINAE and NEPHROCERINAE; however, *Dorilas banksi* (Aczel) and *Allomethus brimleyi* n. sp. possess this type of third segment. The third segment is covered with microscopic pubescence, sometimes densely so, which often gives a silvery sheen to the segment, especially around the margin. The arista appears to be of little importance taxonomically. It is fitted into a pocket on the upper hind margin of the third segment and is divided into three sections. The first, or basal section, is about half the length of the second and the third extends out into an elongate flagellum which is thickened basally and is usually wider near the base than the width of the first and second sections. Usually the whole arista is shining black, although in many species the first two sections and extreme base of third are lighter.

The mouthparts are of the typical muscoid type (fig. 1a, 2a) but dissection and examination of the structures indicates that specific characters are to be found in the rostrum, thyroid (mentum) and possibly the maxillary palpi. The maxillary palpi are elongate annulated structures with no apparent segmentation (fig. 2c), attached at bases to long rods which extend around the pump to the ventral portion of the thyroid (mentum).

Dorsum of thorax usually bare or with microscopic pubescence or pile, with strong bristles only in the CHALARINAE and NEPHROCERINAE. The propleurae is usually hidden by the broad occiput and in many genera possess brushes of long bristle-like hairs; however, *Beckerias*,

Claraeola, Anacephalops, Dorylomorpha, Tömösváryella and the subgenus *Eudorylas* of *Dorilas* have the propleurae entirely bare. The color of the humeri, although not a specific character in itself, is useful in setting off groups of species. The pollinosity of the thorax and abdomen appears to be produced by a covering of microscopic scales. The term metanotum is used here to designate that gibbose portion of the thorax lying beneath the scutellum; this usage may not be correct as there is a morphological question as to whether the true metanotum is present in higher diptera. The legs are usually simple, although the coxae, trochanters and bases of the femora are sometimes ornamented with processes or developments and, in members of Tömösváryella, with strong hairs or bristles. Femora are gently thickened apically with rows of short spines on the apical halves below in most species; the tibiae are gently curved in most species, with many longitudinal rows of short bristles, sometimes with two to many elongate hairs on the dorsal portion, with posterior pair strongly arcuated in many; however, *Tömösváryella contorta* (Hardy) has the femora and tibiae of posterior legs markedly contorted. Tarsi for the most part are rather slender, basitarsi generally equal to the next three subsegments in length; in many of the *Tömösváryella* the posterior tarsi are distinctly dilated, especially in the females. The tarsal subsegments usually possess a number of long fine hairs at their apices. The pretarsi (fig. 2d) are typical of the higher diptera. The tarsal claws are heavily sclerotized and articulate with the terminal tarsal subsegments above. The unguitractor or median basal plate of the tarsus widens basally and fits up under the terminal subsegment, its depressor muscles extending longitudinally down the tarsus on the venter. The empodium arises on the venter from the distal end of the unguitractor with no apparent articulation; it is simple and spinelike, extending three-fourths the length of the pulvilli in the specimens studied. The pulvilli are large and rounding lobes, densely covered with microscopic hairs. They arise from a pair of lateral plates, the auxiliae or auxiliary plates, which lie directly beneath the bases of the tarsal claws.

The wings are for the most part long and narrow, usually as long or longer than the body; *Dorilas latipennis* (Banks) is one exception to this, having short, broad wings. Members of *Tömösváryella* all have comparatively short wings about equal to body length. The wings vary from brownish iridescent to hyaline; however, most species have at least a slight iridescent tinge. The terminology for the

wing venation (figs. 5b, 7b) follows, for the most part, that system which is in general application in the family because of its simplicity. The writer has, however, supplemented this with the Comstock-Needham system as modified by Alexander, Lameere, Martynov and Tillyard for the sake of clarity; the latter modifications are applied in the interpretation of most of the veins as they appear to be more nearly correct. The term *subcosta* is used in preference to auxiliary vein to indicate that vein lying between the costa and first longitudinal vein as this is in more common usage. The first longitudinal vein is equal to R_{1+2}, as the interpretation of Alexander[6] will certainly apply to higher Diptera. The radial sector is two branched, the anterior branch (R_{3+4}) being designated as the second longitudinal vein; the posterior branch (R_5) as the third vein. The true position of vein R_4 is not clearly understood in Dorilaidae. There is a question as to whether it is fused with R_3 or with the basal portion of R_5 and has been lost by atrophy at its tip. In its phylogeny through more primitive groups vein R_4 has migrated to and become fused with R_3 so this interpretation seems more logical. The crossveins are termed r-m and m-cu in preference to "small" and "large" crossveins, using the new interpretation of the position of m-cu; the posterior crossvein is that which connects the two branches of media (Crossvein m); the basal portion of the vein which was formerly known as Cu_1 is now interpreted as the medio-cubital crossvein. The fourth vein (M_{1+2}) is very important taxonomically and may for convenience sake be divided into the following sections: *first section* equals that portion of vein from base to branch of media; *second section* equals that part from branch of media to r-m crossvein; *third section* equals from r-m crossvein to m crossvein and the *last* or *fourth section* is from m crossvein to the wing margin. The comparative length of the second and third sections, in other words the position of the radiomedial crossvein in relation to the discal cell (first M_2), is a good diagnostic character. The presence or absence of an appendage of a vein on the last section of the fourth vein is used as a generic character; this appendage is the rudiment of vein M_2 and is present in the Nephrocerinae as well as the genera *Prothechus, Cephalosphaera, Anacephalops* and most *Claraeola;* the degree of curvature of the last section of fourth vein is of specific importance. The fifth vein (M_{3+4}) may be divided into sections as the fourth but its ultimate section, that portion from the m crossvein to the wing margin, is the only part which appears to be of tax-

6. 1929, International Congress, Ent. IV, Proc.

onomic importance. The length of the petiole of the cubital cell appears to be of some significance. In light of the new interpretation of the posterior veins, the vein considered Cu_2 by Comstock-Needham is now known as Cu_1 and their second anal is now first anal vein; thus their anal cell should actually be the cubital; this interpretation should be given to all previous works in the DORILAIDAE. The costal margin of the wing is divided into sections to facilitate designation: the *first section* is that from the wing base to the humeral crossvein; the *second section* is from humeral crossvein to the apex of the subcostal vein; the *third section* is that portion from end of subcostal vein to end of the first longitudinal vein (R_{1+2}); the *fourth* being that section from end of first vein to end of second (R_{3+4}); the *fifth* extends between the apices of the second and third veins. A stigma may be present or absent in the wing, depending upon the particular genus involved; when present it occupies a small portion to all of the third costal section.

The abdomen varies a great deal in shape but the typical form is subcylindrical, rounding on the sides, widest at segments two to three; sometimes the sides are straight or nearly so; some species may have the abdomen widest at base while others may be narrowed anteriorly and clavate. Abdomen varying from densely pollinose, velvety opaque, subshining to brightly metallic. The genital portion of the abdomen takes in those segments and appendages beyond segment five. It exhibits much torsion and asymmetry toward the left side. The degree of twisting varies a great deal with different genera and species but its evolution can be traced to an extent from the CHALARINAE up through the higher groups. The sixth tergum is dorsal in position and appears to be normal in the more primitive groups. As this plate is followed up through the phylogenetic scale it is twisted to the left towards the venter where it forms a basal plate giving support to the genital structures. The seventh tergum is lateral in position, extending from the dorsum to the venter on the left side; the seventh and eighth segments combined from a large genital chamber into which folds the ninth segment and copulatory structures. The eighth segment occupies the posterior tip of the abdomen in all of the higher groups; however, in the CHALARINAE it is reduced to a relatively small segment occupying the left side of the apex (fig. 9d). The eighth segment is generally large in size and usually possesses a small to large membranous area or depression, often referred to as the *genital cleft,* especially in previous works. Most external genital characters are dependent upon the

particular shape of the eighth segment from dorsal view; the degree of symmetry of this portion, the extent and position of the membranous area etc., are valuable taxonomic characters. The genital appendages usually show great diversity of form and present excellent characters for separation of species. The appendages of the ninth segment are true harpagones, as their musculature has been worked out (fig. 2e); the harpagones are usually alike although the two may differ greatly one from the other. The cerci and anal region are located in a convexity on the distal portion, between and anterior to the harpagones; the cerci are of taxonomic importance in the *Tömösváryella*. The aedeagus varies from a simple tube to bifid or three pronged and may be elongated and coiled (fig. 16f). The accessory plates and structures making up the aedeagus are diverse in form and probably possess specific characters. The musculature of the aedeagus is very complex and is not well understood (fig. 2f).

The recent work of Doctor Marton Aczel[7] is to be highly praised as it is the most valuable contribution that has been made to the study of the morphology of the Dorilaidae genitalia. The terminology employed in his paper, however, appears somewhat cumbersome in light of that applied here in America but the paper illustrates very well the taxonomic importance of the genital structures. In the present work there is no attempt to introduce new and unfamiliar terms as this would only tend to complicate terminology and probably make the paper less usable and understandable. A comparison of the terminologies of the male genital structures as interpreted by this author and that as used by Aczel is given: The *sixth tergum* is termed the "Prahypophygialplatte" (Lamella praehypopygialis) by Aczel; the *seventh tergum* is termed the "Hypopygialplatte" (Lamella hypopygialis), when this plate extends around to the venter it is called "Pseudoforceps"; the *eighth segment* is called "Basalring" (Basis hypopygii) and the *ninth segment* (of this author) is termed the "Basalplatte" by Aczel. The *harpagones* are called the "Mesolobi" (Valvulae mediales or cerci) and the *cerci* are given the name "Pinsel" (Penicillium); Aczel correctly applies the term cerci in his later paper.[8]

The well adapted ovipositing structure of the female is composed of modified seventh, eighth and ninth abdominal segments; the seventh segment sometimes is extended to give the ovipositor greater length as in *Jassidophaga fasciata* (Hardy) (fig. 6d). The seventh

7. 1939, Das System der Familie Dorylaidae, Zoöl. Anz. Band 125, Heft ½; 15-23.
8. 1940, Zoöl. Anz. 1.12, Bd. 132, Heft 7/8.

segment makes up the basal portion and the eighth and ninth are combined to form the actual piercing structure. The ovipositor sometimes shows distinct articulation between the piercer and the base but more often they are completely fused. The anal opening is on the dorsum of the piercer, near the junction with its base, it is conspicuous because of the presence of the pilose cerci, a lobe on either side of the anus. The vaginal opening is on the venter of the ovipositor, usually situated in a thickened portion near the base of the piercer. The piercer is grooved above from the anal opening to its apex, this serves as an egg tube. In copulatory position the long piercer of the female fits up into the genital cavity of the male (fig. 102e) in order that the vagina may be reached by the aedeagus. In this position the male carries the female and often they are captured in this condition, usually separating, however, unless they are killed immediately.

Much remains to be learned concerning the internal morphology of these flies. The writer has made only preliminary studies of the internal systems and structures and the technique is in such an experimental stage that very little actual data have been gathered. Fair success has been had with musculature studies by killing and fixing with Kahl's and Zenker's solutions. The ovaries are difficult to study because of their position and small size; they occupy a relatively small area in the posterior portion of the abdomen, closely attached to the dorsal wall, mainly of the fifth and sixth terga.

ECONOMIC IMPORTANCE

The DORILAIDAE are among the most important of the parasitoid DIPTERA and are no doubt very influential in biological control of many homopterous pests; their full significance is not yet known but this group shows great promise for future control work. They are generally considered parasites strictly of HOMOPTERA but some writers have suggested that they might also parasitize some Hemiptera; Curran[9] states, "The larvae are parasitic on bugs of the families Cicadellidae and Miridae and perhaps on other HOMOPTERA and HETEROPTERA." The writer has no confirmation of their affecting groups outside of HOMOPTERA. They have been definitely associated, in various parts of the world with CICADELLIDAE, FULGORIDAE and CEROPIDAE and European workers have stated that *Nephrocerus* are probably parasites of CICADIDAE but this again is unconfirmed.

9. 1934, Families and Genera of North American Diptera, p. 245.

The most outstanding work on the biology of these flies has been done by R. C. L. Perkins on the Australian and Hawaiian Fauna [10] and by F. X. Williams and Swezey in Hawaii.[11] The DORILAIDAE parasitizing the Sugarcane Leafhopper (*Perkinsiella sacchiricida* Kirk) in Hawaii have been studied thoroughly by these workers and three species were found to be instrumental in control of this pest: *Dorilas* (*Pipunculus*) *juvator* (Perkins), *D. hawaiiensis* (Perkins) and *D. oahuensis* (Perkins). The life cycle of these species requires two to three months.

So few of the known American species have been reared that very little is known about their host relationships. We know that some species of leafhoppers are attacked by more than one species of Dorilaidae but just how host specific the flies are has not been studied in America. Perkins states that *Pipunculus beneficiens* Perkins in Australia, was bred from three or four different species of leafhopper and *P. cruciator* Perkins from two widely different genera. It seems probable that this condition may prove the exception rather than the usual thing when the American species have been more fully worked out, although the unusual distribution of some species suggests that they may utilize more than one host species.

The beet leafhopper (*Eutettix tenellus*) has received considerable attention in western America and our only published biological studies have been in connection with this leafhopper. The work of Severin and Knab in California; Doctor G. F. Knowlton and H. E. Dorst at the Utah Agricultural Experiment Station and Charles Henderson, formerly at the beet leafhopper laboratory in Twin Falls, Idaho, has established quite definitely that two species of DORILAIDAE are concerned in the parasitism of the beet leafhopper in the West; *Tömösváryella vagabunda* (Knab) is by far the most important species involved, while *Dorilas subopacus industrius* (Knab) is comparatively of minor importance; in most localities at least ninety-five percent of the material reared from beet leafhopper will belong to the first species. These flies no doubt play a very important part in helping to keep this pest in check, in dissecting specimens of *Eutettix tenellus* taken in the desert breeding grounds the writer has found as high as forty percent of the specimens containing Dorilaidae larvae. Mr. H. E. Dorst has reported

10. 1903, The Leafhopper of the Sugar Cane. Bull. Board Agri. Forestry Hawaii No. 1; 23-24.

11. 1905, Leafhoppers and Their Natural Enemies. Haw. Sugar Planters Assoc. Expt. Sta., Bull. 1, Pt. 4; 123-157.

that sixty percent of the beet leafhoppers were parasitized the spring of 1936 at the time of the leafhopper migration. T. Esaki and S. Hashimoto[12] reported that sixty-five percent of the *Nephotettix bipunctatus cincticeps* examined in 1935 were parasitized by *Pipunculus*.

The eggs are placed inside the abdomen of the host by the ovipositor piercing the conjunctiva between the segments or by insertion directly through the body wall. This procedure apparently doesn't injure the leafhopper a great deal and the larva grows to maturity along with its host. When the larva is full grown it fills the entire abdomen and often extends part way into the thorax; it then breaks out of the abdomen, killing the host, and pupates as soon as a suitable spot is found. Some species may drop to the ground and pupate in the soil while others pupate on or at the bases of the leaves of plants or in debris, fallen leaves, etc., on the ground.

The larvae are oblong, rounding at ends but slightly more pointed in front; the segmentation is not distinguishable because of the wrinkled nature of the cuticula; however, ten or eleven somites appear to be present. Many species possess microscopic spicules on the cuticula. The exact number of instars has not definitely been determined; from study of the available larvae there appears to be four distinct instars, although there may prove to be five, as often there seems to be five growth stages from the young to the mature larvae. The mouth is just a simple opening with no indication of external mouth parts; however, a pair of heavily sclerotized, darkly colored mandibles "mouth hooks" are present; these "hooks" appear in the first instar and are shed with the last moult. The larvae are amphipneustic, with only the first pair and posterior spiracles open; the anterior pair are located near the sides, usually just posterior to the "mouth hooks" (figs. 3a-c). The posterior spiracles are situated on a sclerotized plate located in the middle just anterior to the posterior end of the larva. There appears to be two or more pairs of spiracles that open in this stigmal area. The arrangement of the spiracles and processes of these stigmal plates (figs. 4a-d) as well as the structure of the mandibles apparently are diagnostic for separation of the species in the larval stage; lack of material has prevented further investigation of this subject.

12. 1936, Report on the Leafhoppers Injurious to the Rice Plant and Their Natural Enemies. Fukuoka, Ent. Lab. Dep. Agri. Kynshu, Univ. No. 7, 31 pp., 5 pl.

The earlier instar larvae are more slender and the mouth hooks seem more pronounced. The writer has been unable to find indications of spiracles until the last instar, and stigmal plates seemingly develop at the last moult. The later instars become more flattened out, and shorter in proportion to their width, the cuticula becomes wrinkled and somewhat darker. When the larva breaks from the abdomen of the host, the last larval skin is retained, becomes darker in color and hardens to form the reddish brown puparium.

The first instar larvae of *Tömösváryella vagabunda* (Knab) in *Eutettix tenellus,* are about the length of an abdominal segment of the leafhopper and increase a little more than the length of the sternum in each distinct growth period. The young larvae are very near the size, shape and color of the leafhopper eggs but can be recognized by the presence of the dark colored mandibles. Larvae are much harder to locate in dark bodied hosts. The larvae usually face anteriorly in the body of the host; however, specimens dissected from *Ballana sp.* were directed posteriorly.

The writer has dissected out many species of DORILAIDAE from various genera and species of leafhoppers, but as the life histories have not been worked out, the larvae are unidentifiable.

COLLECTING AND METHODS OF STUDY

Although the DORILAIDAE are comparatively rare in collections, they are usually very abundant in nature, especially in certain situations. A greater variety of species are to be taken by sweeping in grasses of various kinds than in any other type of habitat, although they may be collected in a great many different plant associations, depending upon their particular host requirements. The inconspicuousness of these flies and the fact that small DIPTERA are for the most part unattractive to most collectors accounts for their scarcity in collections. A little effort put forth in sweeping most any grassy meadow will usually yield several species, often in large numbers. These flies are definitely seasonal, most species being more abundant in the spring and fall, due, of course, to two generations per season. In many situation where Dorilaids were numerous in the southeastern and southwestern parts of the United States, the writer has attempted to associate them with their homopterous hosts by taking numerous leafhopper samples and habitat notes. Shortage of time has prohibited the dissection of these numerous samples, so the parasitism data are not available at this time.

HABITAT STUDIES

Throughout several collecting seasons the writer has gathered data concerning the plant associations and situations in which DORILAIDAE have been taken. It has been found that most any grassy situation will usually yield one to many species, depending, of course, upon the time of the season, as the abundance of some species varies a great deal throughout the spring, summer and fall. A day's difference often makes a striking contrast in the abundance of any particular species; in fact, even the hour of the day plays a very important part in the abundance or scarcity of individuals. A few miles southeast of Ely, Nevada, Doctor R. H. Beamer and the writer collected in a tall cheat-like grass and found the DORILAIDAE very scarce from seven o'clock until eight in the morning. Shortly after that time they became very numerous. Specimens of a number of species were common, hovering along a small mountain stream above Tajique, New Mexico, from about nine to ten a. m. After this time none were taken. The writer spent several days in the Chiricahua Mountains in Arizona observing DORILAIDAE hovering along small streams. Specimens of *Cephalosphaera maxima* n. sp. were seen only between nine-thirty and ten o'clock in the morning. In this same locality *Chalarus spurius* (Fallen) were exceedingly abundant in willows from two to four o'clock in the afternoon, while at dusk they were very scarce. Early in the morning no specimens could be found. *Dorilas ater* (Mg.) and *Chalarus latafrons* n. sp. were observed hovering over huckleberry oak in Yosemite National Park, California, during the early part of the morning, but as the day became warmer these became scarcer. These are but a few of the examples in which their abundance appears to be influenced by temperature, moisture, shade, sunlight and perhaps other factors. It has been discovered that many species of *Dorilas* and a few *Cephalosphaera* were attracted to water and moist situations, especially in mountainous regions. Some of the best DORILAIDAE collecting is to be had by sitting beside a small mountain stream and taking the specimens as they come in to the water. These are readily seen as they hover in the sunlight and, if one observes them a short while, they will usually alight upon a moist stone, leaf or twig and appear to be lapping up moisture. Doctor Beamer and the writer have found that these could easily be aspirated directly out of the air as they hovered, or from the stones, etc., as they were resting. A situation of this kind will ordinarily yield a variety of different species, many of which are seldom taken in other places, possibly because they may

parasitize arboreal leafhoppers and not be easily obtainable in their natural habitat. It is strongly suspected that oak leafhoppers may serve as hosts for many of these species as oaks have been the predominant trees in all localities where this phenomenon has been observed. It is not unusual to take specimens hovering in the shade or in the sunlight beneath trees. Specimens of *Dorilas hauchucanus* n. sp. were often taken in camp (in Arizona mountains) at meal time, hovering over liquids, open milk bottles, coffee in cups, water buckets, etc., and could be aspirated out of the air if one would cautiously approach, with the aspirator tube, the spot where they were hovering. The inquisitive flies would often approach or even alight upon the end of the tube of the aspirator.

A few of the grasses from which Dorilaids have been taken are as follows: Bermuda grasses have yielded *Tömösváryella subvirescens, T. bidens, T. agnesea* and many others; salt and buffalo grasses, *Tömösváryella spp.* of the *similis, toxodentis, utahensis* and *vagabunda* groups; blue grass, *T. contorta* and *spp.* in *subvirescens* and *similis* groups; redtop, panic grass and tickle grasses, *Tömösváryella spp., Dorilas spp.* and *Dorylomorpha exilis* et. al.; Johnson grass, *Dorilas spp., Tömösváryella agnesea* and spp. of *subvirescens, similis* and *toxodentis* groups; short desert clump grass, *Tömösváryella xerophilus, tumida* and *wilburi;* tall clump grasses, *Dorilas minor, D. subopacus industrius, Tömösváryella vagabunda* group, *subnitens* and *agnesea;* slough grasses, *Tömösváryella;* orchard grasses, brome, millet, gama grasses et al. have yielded many species. Comparatively few specimens were collected in sedges throughout southeastern United States, the summer of 1939 but in the Southwest and West the summer of 1940 the sedge meadows were found to contain a great variety of species. This appears to be the natural habitat of the western species of *Dorylomorpha* and is the only environment in which the writer has taken members of this genus *Dorilas nigripes, ater, banksi, varius mainensis, affinis, fuscus,* et al., *Chalarus latafrons, Tömösváryella sylvatica, coquilletti* and others have been collected in sedges also.

The *Arundinaria* (cane) in southeastern United States contains two species of *Dorilas, minor* and *alternatus,* which apparently parasitize leafhoppers of the genus *Arundanus,* or the fulgorid, *Stenocranus arundineus* Metcalf, or perhaps both. A number of different kinds of oaks throughout the West have produced *Chalarus latafrons, spurius, Dorilas ater,* et al. and Tömösváryella of the *similis* and *utahensis* groups. *Chalarus spurius* and *latafrons* have been

taken commonly in willow, probably associated with *Empoasca; C. latafrons* has also been taken hovering in the sunlight beneath aspen trees where *Empoasca* and *Idiocerus* leafhoppers were thick in the trees. The beet leafhopper parasites, *Tömösváryella vagabunda* and *Dorilas subopasuc industrius* are commonly taken on *Eutettix tenellus* host plants, i. e., *Salsola pestifer, sofia, filaree, Atriplex spp.,* and *Beta vulgaris.* Doctor Knowlton adds: *Atriplex rosea, Atriplex argentia, Atriplex nuttali, Bassia hyssopifolia* and blistercress or *Cheirinia repanda.* Other plant associations are as follows: *Ceanothus,* yielding *Chalarus latafrons, Tömösváryella spp., utahensis* group; alfalfa, *Dorilas subopacus industrius, Tömösváryella subvirescens* and spp. of *vagabunda* groups; *Chambaebatia foliolosa* (Bear clover), *Tömösváryella bidens, subvirescens* and spp. in *utahensis* and *similis* groups; *Arctostaphylos pungens, Chalarus latafrons.* The manzanitas haven't been systematically collected for Dorilaids but since these plants support such a fauna of leafhoppers they certainly should serve as a potential habitat for these parasites. Fern growth has yielded, *Dorilas subopacus industrius, Tömösváryella spp.* and *Chalarus spurius;* dogwood, *Dorilas sp.; Chrysothamnus* and *Artemisia, Tömösváryella spp.* taken in copula on bushes; wild licorice (*Glycyrrhiza*), smart weed (*Polygonum*) and wild mint (Mentha) several species of *Tömösváryella,* possibly accidentals; wild columbine and lupine meadow, *Tömösváryella utahensis* and *vagabunda* group; dense forest undergrowth, *Dorilas spp. Chalarus spurius* and *Tömösváryella spp., utahensis* and *similis* groups; one specimen of *Dorilas affinis* has been taken on *Pinus ponderosa* but this was probably an accidental.

Occasional specimens of *Dorilas ater* (Meigen) and *Charlarus latafrons* n. sp. have been taken at light but this is certainly not a common behavior.

METHODS OF PREPARATION FOR STUDY

The best method for mounting DORILAIDAE is on paper points, bending down the point slightly at the tip and taking care to attach the fly firmly on the right pleura, high enough that the legs are entirely free. In the genus *Tömösváryella* it is especially essential that the specimens be mounted securely and neatly so the legs are available for study and the abdomen may be dissected without detaching the specimen from its attachment. The more essential diagnostic characters for this genus are found on the posterior trochanters and femora, middle coxae and in the male genital structures. It

is extremely irksome to receive specimens for determination which have been placed "feet first" in an excess amount of glue which obscures all of the leg characters; such specimens are useless unless remounted. In this respect it might be well to make a plea that a celluloid glue be used, then if for some reason remounting is necessary the specimen can be removed from the point without being injured. It is likewise troublesome if the specimen is not glued firmly to the tip or if the glue used was not of the right consistency. Glueing to the side of the pin as recommended by Curran for small Diptera is not satisfactory for these flies as the bases of the legs are apt to be glued down, if this method is used it is desirable to attach the specimens to the ring of glue toward the upper portion of the pleura so the legs are directed at a slight angle away from the pin. Minuten nadeln make very good mounts, but if the specimen thus mounted is to be dissected it should be relaxed first, as dry nadelned specimens often break in the thoracic region when the genitalia are clipped off.

In order to study the genital structures it is usually necessary to dissect off the apical portion of the abdomen at the third or the hind margin of the fourth segment depending upon how far forward the harpagones extend on the venter. This portion is removed by fine dissecting scissors in a dry or relaxed state depending upon the specimen, or it may be taken off by first relaxing the specimen and then carefully picking a line around the sclerites of the abdomen with a fine needle; this method may be speeded up somewhat by further softening the cuticula by painting a line of hot caustic potash where the dissection is desired. After removal the terminal portion is placed in a ten-percent aqueous solution of caustic potash and allowed to stand for one to twelve hours according to the amount of sclerotization; or the part may be sufficiently cleared in one to three minutes in boiling caustic. After this clearing and relaxation it may be transferred directly to glycerin for study. To obtain an unobstructed view of the harpagones it is usually necessary to lift the genital portion of the abdomen away from the genital chamber which lies on the right side under the fifth and part of the fourth segments.

Numerous methods for preservation of the hypopygia have been tried but the most successful from all standpoints has been simply to place them in minute vials in a very small bit of glycerin, these are placed upon the pin with the specimen; flat-bottomed shell vials, 4×10 mm. are used. It is essential that only a small amount of glycerin be placed in the vial, just barely covering the bottom, and

that the pin be placed through the cork on a slant so the liquid and the stopper will not come in contact; if this happens, the osmotic pressure will draw the fluid from the vial through the cork. The first method tried was to mount the structures on microscope slides. This required additional time in preparation and was not entirely satisfactory. It is often difficult to obtain a true conception of the genitalia in a mount of this kind because of the flattening and distortion caused by the pressure of the cover glass. This distortion has been remedied by using rings or by placing fine pieces of glass rods upon the slide to support the slip so it will not actually contact the object; however, in this type of mount the convection currents may sometimes cause the edges of the sclerites to curl under. It is rather cumbersome to take care of materials when the genitalia are on a slide, often remote from the specimen on the pin and the view is usually too fixed. The next method tried was to clear the genitalia, extend and place the structures as desired, dehydrate to xylol and mount them on the tip of a minuten nadeln. This works rather well with larger specimens but upon drying the whole structure shrivels slightly, causing some deformity, making it difficult to observe the details that are sometimes needed. The last two mentioned procedures allow only a fixed perspective of the parts while that in the liquid medium permits free movement of all the structures as needed.

In working with DORILAIDAE it has been necessary to work out a technique for replacing the heads as these flies are notorious for the ease with which their heads drop off; it is often impossible to handle specimens without them becoming decapitated. The writer has found that the best method of glueing these is to use clear shelac; a small amount is applied to the cervix by using a fine insect pin which has been bent at the point to hold the droplet at the very tip of the pin, this facilitates the accurate placing of the glue so that no more than necessary is applied. The head may then be picked up by moistening a clean pin and touching it. The head then can be placed in its proper position, usually with no harm done. Cellulose glue has been found to dry too rapidly to permit orientation of the head.

LEAFHOPPER DISSECTION

In searching for dorilaid larvae the leafhoppers are dissected with small needles, one needle being placed on the posterior end of the abdomen (genital segments) to hold the specimen firm, with the other needle the head and thoracic segments are removed one by

one. If a full grown larva is present the anterior end will be visible protruding from the base of the abdomen. The mature larva is recognized by size, darker color and hardness. The larva can be removed by carefully picking away the abdominal sclerites until it is fully exposed. By removing the segments from one to four and prying through the contents of the abdomen the smaller larvae, if present, can readily be found; these are easily recognized by their conspicuous mandibles. The observer may rarely find two first instar larvae in the abdomen; but certainly under such conditions in nature one or both of the parasites would be killed due to crowding of the larvae as development continues in the leafhopper abdomen. There is apparently no sure way to recognize a parasitized leafhopper externally, however, male specimens which contain mature larvae usually have the abdomen abnormally distended. A parasitized female has the same appearance as one which is gravid. In cleared specimens the dark mature larvae may sometimes be seen through the cuticula.

FOSSIL DORILAIDAE

Our knowledge concerning the fossil DORILAIDAE was brought up to date recently in the commendable study by Carpenter and Hull,[13] this paper describes four new species, bringing the total number of known species up to six. These belong in four extant genera: *Protonephrocerus, Nephrocerus, Prothechus* and *Cephalosphaera* and excepting one species, *Protonephrocerus florissantius* Carpenter-Hull, described from Florrisant, Colorado (Miocene), all are from Baltic amber deposits (Oligocene). These species all exhibit the primitive forking of the main branch of medius and in *Protonephrocerus collini* Carpenter-Hull vein M_2 extends to the wing margin. Aside from the above mentioned the following are the known fossil species: *Prothechus succinius* (Meunier), *P. extinctus* (Meunier), *Nephrocerus oligocenicus* Carpenter-Hull, and *Cephalosphaera baltica* (Carpenter-Hull).

KEY TO DORILAIDAE GENERA OF THE WORLD

1. Ocellar bristles present; head hemisperical; occiput very narrow, scarcely visible from lateral view; densely pilose species.....(Charlarinae). 2
   No ocellar bristles; head nearly spherical; occiput generally swollen and plainly visible; usually not densely haired..... 4

2. Wing venation complete, discal cell closed..... 3
   Wing venation incomplete, discal cell open apically, posterior crossvein (median crossvein) and major part of veins M_{1+2} and anal vein lacking (fig. 9b),
   Chalarus Walker, p. 32

13. 1939, Bernstein-Forschungen, 4; 9-17.

3. Fourth vein (M_{1+2}) appendiculate, with a fork or appendix beyond posterior crossvein (fig. 5b).....*Prothechus* Rondani, p. 26
Fourth vein normal, no appendix.....*Jassidophaga* Enderlein p. 29

4. Hind margin of each eye with a deep excision at middle; margins of mesonotum and scutellum with strong bristles; third antennal segment reniform or obtusely pointed below .....(*Nephrocerinae*) 5
No strong excision on hind margin of eyes; without strong mesonotal or scutellar bristles; third segments of antennae usually pointed below..... 6

5. Stigma absent, axillary lobe of wing present, wing margin not formed by anal vein; third antennal segment reniform; propleurae with a fringe of long hairs.
Nephroecerus Zetterstedt, p. 37
Stigma present and filling the elongate third costal section; no axillary lobe to wing, the wing margin being formed by anal vein; third segments of antennae more elongate and obtuse below; propleurae bare.....(Chile and Argentine)
Protonephrocerus Collin, p. 37

6. Anal vein complete, reaching wing margin or verging with the cubital vein..... 7
Anal vein lacking, except for a rudiment present at base.....(Hungary).
Beckerias Aczel, p. 127

7. Stigma absent; no darkened area between the subcostal vein and end of R_{1+2}.
(Tömösváryellinae) 11
Stigma present, usually filling most of the third costal section and very conspicuous.
(Dorilainae) 8

8. Posterior lobe of wing well developed; third antennal segment scarcely larger than the second, generally obtuse below; vein M_{1+2} usually forked (one large species from Formosa, 7.5-8 mm.).....*Claraeola* Aczel, p. 127
Posterior lobe of wing rudimentary or scarcely developed; third antennal segment much larger than second, usually acute or acuminate; vein M_{1+2} may be forked or simple; usually much smaller species..... 9

9. Fourth vein (M_{1+2}) with an appendix beyond posterior crossvein (fig.) 12h..... 10
Fourth vein normal .....9a. *Dorilas* Meigen, p. 54
9a. Propleurae with a fan of long hairs.....*Dorilas* (*Dorilas*) Meigen, p. 55
Propleurae bare, not haired.....*Dorilas* (*Eudorylas*) Aczel, p. 55

10. Third costal section closed by a supernumerary crossvein; base of abdomen yellow in all known species, (known only from Australian Zone).....*Collinias* Aczel, p. 127
Third costal section always open never closed by a crossvein.
Cephalosphaera Enderlein, p. 40

11. Vein M_{1+2} forked, M_2 present as an appendix.....*Anacephalops* Aczel, p. 128
M_{1+2} simple, vein M_2 fused with M_1..... 12

12. Crossvein r-m situated near basal portion of discal cell..... 13
Crossvein r-m situated at about middle of discal cell; eyes of male contiguous for at least a short distance on front.....*Tömösváryella* Aczel, p. 144

13. Eyes of male dichoptic; abdomen strongly swollen posteriorly, narrowed basally, clavate in both sexes; male hypopygium large and conspicuous; third antennal segment acuminately pointed below.....*Dorylomorpha* Aczel, p. 131
Eyes of male contiguous on the front; abdomen gently tapering posteriorly; male hypopygium small, inconspicuous; third antennal segment acute to obtuse or rounding below .....*Allomethus* n. genus, p. 128

Prothechus Rondani

Prothechus Rondani, 1856, Dipt. Ital. Prodr. I, 139.
Prothechus Becker, 1897, Berl. Ento. Zeitschr. XLII, 93.
Verrallia Mik, 1899, Wien. Ent. Zeit. 18, 137. This is a change of name for *Prothechus* Becker, nec Rondani.
Prothecus Hough, 1899, Bost. Soc. XXIX, 85.

Prothecus as listed in Rondani's index, Scudder's Nomenclator Zoologicus and as used by Hough et. al. is a typographical error, as is *Protechus* as listed by Sack, 1935, Die Flieg. der Palear. Reg. Lief. 93, 5.

Prothechus Rondani was apparently based upon a misidentified genotype. This was given as *Pipunculus auctus* Fallen yet it seems evident from Rondani's description that he had a specimen of *Dorilas sens. lat.* before him. His description states "Venae quintae longitudinalis cubitus appendics venosa praeditus....antennae articulo. Tertio inferne acuminato sublanceolato." This description applies only to the appendiculate group of the old *Dorilas,* now recognized as a distinct genus (*Cephalosphaera*). It has previously been stated by Mic[14] and Verrall[15] that Rondani's species was actually *Pipunculus furcatus* Egger as this was the only European species possessing the furcate third longitudinal vein and an acuminate third antennal segment.

Doctor Marton Aczel recently described a second European species in this group, *Cephalosphaera germanica,* so there is no way of knowing which of these species Rondani described. Becker[16] redescribed Rondani's genus *Prothechus* basing his description upon the true *P. auctus.* Mik [14] discussed this question and stated that the genus described by Becker was very different from that of Rondani. He proposed the name *Verrallia* to take the place of *Prothechus* Becker, preoccupied by *Prothechus* Rondani. The procedure established by the International Commission in Opinion 65 is not in accord with Mic's action and *Verrallia* Mic should be considered an isogenotypic synonym of *Prothechus* Rondani. Opinion 65 is as follows:

"65. Case of a Genus Based upon Erroneously Determined Species.—If an author designates a certain species as genotype, it is to be assumed that his determination of the species is correct; if a case presents itself in which it appears that an author has based his genus upon certain definite specimens, rather than upon a species, it would be well to submit the case, with full details to the Commission. At the present moment, it is difficult to lay down a general rule."

14. 1899, Wien. Ent. Zeit. XVIII, 137.
15. 1901, British Flies, VIII, pp. 63-70 and 80.
16. 1897, Berl. Ent. Zeit. XLII, 139.

In accordance with this opinion *Prothechus* must be recognized as defined by its named genotype, therefore this name must replace *Verrallia* Mic. This action has been approved by the committee on nomenclature at the United States National Museum.

This genus is characterized by having the head hemispherical, ocellar bristles well developed, third antennal segment rounding apically, and the fourth vein (M_{1+2}) with an appendix beyond the posterior (median) crossvein; rather densely pilose species.

Genotype: *Prothechus auctus* (Fallen) (*Cephalops*).

Two North American species belong in this genus; they can be separated by the following characters:

A. Stigma long, as long as third costal section.....*auctus* (Fallen), p. 27
AA. Stigma short, not over one-half as long as third costal section
csikii (Aczel), p. 28

Prothechus auctus (Fallen)

(Plate 1, figs. 5a-c)

Cephalops aucta Fallen, 1899, Wien. Ent. Zeit. V. 18, 137.
Verrallia virginica Banks, 1915, Psyche, 22, 169. New synonymy; this appears to be the same as the European species *auctus* (Fallen).

Male. Head: Eyes very narrowly separated along the front; lower one third of front and all of the face densely silvery pubescent; narrowed upper portion of front opaque black; occiput very narrow; hind margins of compound eyes not indented; antennae black, third segment rounding below, second segment bristly (fig. 5a). *Thorax:* (and abdomen) opaque black with rather dense black hairs and strong bristles; margins of thorax, pleurae and metanotum cinereous; lateral margins and narrow apices of abdomen faintly silvery; humeri brownish to black; halteres yellowish brown; propleurae each with a group of four to five long pale hairs on the anterior margin and another group of three to four hairs on the lower edge of the posterior margin; legs chiefly black; apices of femora and tibiae and bases of tibiae yellow; tarsi yellow to brown; femora narrow, rather thickly yellow haired but bristles not well developed; sides of abdomen almost straight, gradually narrowing from the first segment posteriorly; lateral margins densely haired, pile pale and dark intermixed; second segment about equal to fifth in length; third and fourth shorter. *Wings:* Iridescent; third costal section slightly longer than fourth, stigma filling most of section; fifth section of costa much shorter than third and fourth combined, crossvein r-m situated beyond the end of the subcostal vein and just before the middle of the discal cell; appendix on fourth vein (M_{1+2}) rather short to medium in length, usually about as long as the dis-

tance from the posterior crossvein to the fork of M_{1+2}; ultimate section of fifth vein longer than the posterior crossvein; cubital cell with a rather long petiole (fig. 5b). *Hypopygium:* Much the same as in *Chalarus* from dorsal view, there is no essential difference in the general make-up of the hypopygium; sixth segment plainly visible but short (in specimens studied), about one fourth to one fifth length of fifth segment; segment seven slightly longer than six and on left side of hypopygium; segment eight occupies left side of apex and nine is directed anteriorly up into the genital chamber with a pronounced carina down middle (fig. 5c).

Length: body, 4.5-5 mm.; wing, 4.8 mm.

Female unknown in America. The following description is from G. H. Verrall, 1901, British Flies:

"Not at all similar, but easily known by the fork in the terminal portion of the discal vein and by the short stigma. Frons nearly equal in width and all whitish except about the vertex; the bristles beneath the second antennal joint are pale; the back of the head is not puffed out.

"Thorax with abundant blackish pubescence, and with the strong chaetotactic bristles more conspicuous and all black; pteropleurae with slight soft pubescence.

"Abdomen less grey than in *V. pilosa* about the base, and with the grey side spots more confined to the hind corners and hind-margins of the segments, and with the pale pubescence about the sides of the second segment more confined to the base. Hypopygium longer but less thick than in *V. pilosa,* being not swelled out at the base beneath the fourth nor even the fifth abdominal segment.

"Legs with the bristles in front of the hind femora strong and black, though shorter and more numerous than in *V. pilosa.*

"Wings with the stigma shorter than the next segment of the costa, and with the middle cross-vein hardly after the middle of the discal cell. Squamae orange. Halteres dark orange.

"Length about 4½ mm."

Species described from Europe. Fallen's type is possibly at Stockholm.

The type locality of *virginica* Banks is Glencarlyn, Virginia. The writer has studied this specimen in the Cambridge Museum of Comparative Zoölogy, also specimens from Pringle, South Dakota, July 13, 1924, and Nantucket, Mass., August 19, 1927 (Johnson).

Prothechus csikii (Aczel)

Verrallia csikii Aczel, 1940, Zoöl. Anzeiger 1.12, Bd. 132, Heft 7/8, 152. Change of name for *Pipunculus opacus* Williston, (nec Fallen, 1816) 1886, Trans. Amer. Ent. Soc. XIII, 295.

Following is the original description of Williston's *opacus:*

"*Female.* Black, abdomen narrowly gray fasciate; face white; legs chiefly black; thorax with bristles; fourth longitudinal vein with a stump, crossvein near middle of discal cell, stigma small. Length 6 mm.

Front below and the face silvery white; front elsewhere black, grayish pollinose. Antennae black, third joint large, reniform, silvery on the front and inner side. Dorsum of thorax and scutellum black, apparently gray pollinose, with black pile, and on the postalar callosities and scutellum with black bristles, pleurae pollinose, abdomen depressed, opaque black, the posterior margin of the segments narrowly, and the sides, gray pollinose; along the sides in front with light yellow, behind with black pile. Legs black, femora gray pollinose; tip of femora, base and tip of tibiae and all tarsi yellowish white. Front, and especially the middle, femora behind with white pile, hind femora and tibiae with fine bristly hairs. Wings nearly hyaline, stigma small, brown; anterior crossvein near middle of discal cell, last section of fourth vein angulated and with a stump.

One specimen, Washington Territory."

Location of type unknown.

The writer has not seen this species.

Jassidophaga Enderlein

Jassidophaga Enderlein, 1936, Diptera Tierwelt Mitteleuropas, Bd. VI. 3, p.

This genus was erected to include those DORILAIDAE having the ocellar bristles well developed, occiput scarcely developed, head hemispherical and the fourth vein (M_{1+2}) normal, without an appendix beyond the posterior crossvein. This has been separated from Prothechus wholly on the basis of the presence or absence of the appendix on the fourth vein and whether it should stand as a distinct genus is entirely controversial. It is not uncommon to find specimens of *J. pilosa* (Zett.) which have a very short appendage on the fourth vein.

Genotype: *Jassidophaga pilosa* Zetterstedt, 1840, Insect Lapponica, 579 (Pipunculus).

The two North American species may be distinguished by the following characters:

A. Third section of the costa at least twice as long as the fourth. Female ovipositor rather short and thick, seventh abdominal segment not prolonged.....*pilosa* (Zetterstedt), p. 31

AA. Third section of costa about equal to fourth in length, female ovipositor long and slender, seventh abdominal segment prolonged, serving to elongate the base of the ovipositor, *fasciata* (Hardy), p. 29

Jassidophaga fasciata (Hardy)

(Plate 1, figs. 6a-d)

Verrallia fasciatus Hardy, 1939, Journ. Kans. Ent. Soc. V. 12, No. I, 16-17.

The following is the original description of the female:

"This species appears to more closely approach *pilosa* (Zett.) than *virginica* Banks but differs markedly from this species in having the fourth section of

the costa longer than the third, stigma not over one-half the length of the fifth section; bristles all black; front silvery; ocellar bristles strong; halteres yellow; humeri black; piercer of ovipositor longer, more slender and femora without tuberosity.

"*Female.* In addition to the above characters the first two segments of the antennae are black, the second with stout black bristles above and fine, long, yellow pile beneath; the third segment brown and reniform, with a fringe of yellow-white pile (fig. 6a). *Head:* Face and front silvery, this being brought about by the dense covering of silvery pubescence. Face convex from lateral view. Front slightly narrowed at the halfway point between antennae and the vertex, the sides not being parallel as in *pilosa.* Occiput chiefly silvery but scarcely visible from side view.

"*Thorax:* Opaque gray, slightly brownish on the posterior half of mesonotum. Pleurae, metanotum and scutellum, also posterior one-half of each abdominal segment, silvery gray. Bristles of the thorax strong, four pairs of the scutellum; all bristles black except for two to three pairs of notopleurals which are yellow. Dorsum with rather abundant yellow pile. *Legs:* Coxae, trochanters and femora black with gray pollen, extreme tip of femora, tibiae and tarsi yellow, last two tarsal segments brownish. Femora without tubercles or strong bristles, but with numerous rows of long yellow hairs.

"*Abodmen:* Slightly tapering, as viewed from above, widest at segments one and two. First two segments opaque brownish on their anterior halves, segment two one and one-third times longer than third. Segments three, four and five subopaque black anteriorly, fifth segment one and one-fourth times longer than fourth and about equal to sixth; sixth tergite somewhat pointed on its posterior margin. Segments six and seven entirely gray dusted, faintly shining, seventh protruded, long and narrow, serving to elongate the base of the ovipositor. First abdominal segment entirely yellow pilose, densely haired on the sides; second segment chiefly so, with one row of black hairs on the posterior border, hairs of abdomen otherwise black. Ovipositor elongate, gently tapering from the base into a long narrow piercer (figs. 6c-d) extending beyond anterior portion of third segment.

"*Wings:* Hyaline, faintly iridescent; third costal section three-fourths as long as fourth. Stigma brown, almost completely filling third costal section. Third and fourth costal section equal to or little longer than fifth. Ultimate section of fourth vein slightly sinuate, last section of fifth longer than posterior crossvein. Anal (cubital) cell with a long petiole. Crossvein r-m at about middle of the third costal section and before middle of discal cell.

"Length: Wing, 5 mm.; body, 4.3 mm."

Male. The male has not been definitely associated with the female; however, the specimen at hand compared in all respects with the type female. Compound eyes very narrowly separated on the front; lower one third of front silvery pubescent, upper two thirds subshining to opaque black, mesonotum very densely pilose, more opaque black, not so grayish as in the female and the abdominal vittae are not so pronounced. *Genitalia:* The sixth tergum is dorsal in position, not at all twisted to the left; the seventh

is well developed and largely on the left side, extending on the dorsum to the ninth segment; the eighth segment is rounding and symmetrical, occupying the left side of the apex; the ninth segment is cleft dorsally, as in *Chalarus* and occupies the right side of the hypopygium; the sclerite separating the ninth from the eighth extends longitudinally just to the right of a middle line (fig. 6b); the ninth segment is cleft almost to base from ventral view; the harpagones are flattened laterad, broad at apices and densely haired; no distinct articulation has been observed between the claspers and ninth segment.

Type locality: Durango, Colorado.

Type in Snow Entomological Collection.

The male described above is from Ruidoso, New Mexico, June 28, 1940 (D. E. Hardy).

Jassidophaga pilosa (Zetterstedt)

(Plate 2, figs. 7a-c)

Pipunculus pilosa Zetterstedt, 1840, Insecta Lapponica, 579.

This European species is the most common species of the genus found in America. In the material which has been examined all degrees of intergradation have been observed from *pilosa* Zett. (possessing a distinct wart on the hind femora) to *villosa* v. Ros. (having no sign of a wart on the femora); in the males it is sometimes entirely lacking on one femur but fairly distinct on the other. No structural difference other than the slight variation in the development of this tubercle has been seen and they certainly do not appear to be distinct species; the *villosa* of Europe apparently does not occur in America.

Male. Head: Eyes very narrowly separated on the front, almost converging at the middle of the distance from the antennae to the ocelli; face and lower one third of front silvery; mouthparts yellowish tinged; first two joints of antennae brown to black, second segment bristly, with long yellow bristles below and shorter dark bristles above; third segment yellow-brown, more yellowish around margin, densely pale pubescent. *Thorax:* Opaque black to subshining with rather thick pale to black pile and marginal bristles; pleurae and metanotum grayish; humeri and halteres brown with yellowish tinge; pteropleurae pilose above, propleurae with a brush of five to six dark hairs; legs chiefly black, yellow on apices of femora and bases of tibiae; tarsi brownish; femora slender, with no distinct bristles below but with long serial hairs on sides. In typical pilosa the posterior femora have a distinct wartlike tubercle beneath

at about middle. Abdomen opaque black to subshining, lateral margins grayish, densely pilose. *Wings:* Faintly brownish, third section of costa twice as long as the fourth, stigma almost completely filling third section, fifth section of costa about equal to the third; crossvein r-m situated much beyond the end of the subcostal vein and at about the middle of the discal cell; ultimate section of fourth vein slightly sinuate, last section of fifth vein slightly longer than posterior crossvein; cubital cell with a long petiole (fig. 7b). *Hypopygium:* Very much like that of *Prothechus auctus* (Fallen) the sixth segment is longer, being more than one-half the length of the fifth and the ninth is slightly grooved longitudinally (fig. 7a) instead of being so distinctly carinated.

Length: body, 4.5 mm.; wing, 4.8 mm.

Female. Face entirely silvery, thorax and abdomen cinereous, brownish in ground color. Humeri and legs yellowish tinged, halteres yellow. Tubercle on hind femora, beneath, much more distinct than in male, sometimes with a small wart on the underside of the middle femora. Pile of thorax entirely yellow. Ovipositor rather short and broad (fig. 7c). Posterior portion of abdomen swollen; the sterna distended, with stout black bristles in addition to the long yellow hairs. Slightly smaller in size than the males.

Length: body, 3.8 mm.; wings, 4.8 mm.

Originally described from Europe.

Type in Zoölogical Museum, University of Lund.

The writer has seen this species from Randolph, New Jersey, June 20, 1925; N. Adams, Mass., June 19; Eastport, Maine, July 16, 1909; Mt. Greylock, June 15, 1906, (Johnson); Auburndale, Mass., June 24 (Johnson); Halfway H. Mt., W. New Hampshire, July 6, 1904; Buttonwoods, New Hampshire, June 26, 1913, (Johnson); S. W. Harbor, Maine, June 16, 1921, (Johnson); Mt. Equinox, Vt., June 5, 1910, (Johnson); Bar Harbor, Maine, June 7, 1921, (Johnson); Franconia, New Hampshire (Mrs. Slosson); and Foot Cliff Mt., Essex, Covey Hill, Que., June 17, 1924, (C. H. Curran).

Chalarus Walker

Chalarus Walker, 1834, Entom. Magaz., II, p. 269.
Ateleneura Macquart, 1834, Rec. Soc. Sci. Lille, 356. (Ateleonevra Scudder).

This is perhaps the most easily recognized genus of DORILAIDAE because of its peculiar wing venation. The fourth vein (M_{1+2}) extends just beyond the r-m crossvein then disappears, median crossvein (posterior) is entirely lacking so there is no closed discal cell in the wing, the anal vein is also obliterated. If a specimen is held

in the light just right the faint outline of the missing veins and crossvein can be seen. The third antennal segment is reniform to oval. Head hemispherical with the occiput narrowly visible from side, hidden by the margins of the compound eyes; ocellar bristles distinct, eyes of male dichoptic. Small, rather densely haired specimens. The segmentation of the genital portion of the abdomen is clearly demonstrated in this genus as all of the segments (1-9) are visible from dorsal view. The twisting towards the left side is just beginning and from this point the evolution of the torsion of the genital segments can be traced up through the higher genera. The ninth segment of male is divided longitudinally by an elongate split that extends down the middle about to base on dorsum.

Genotype: Pipunculus holosericeus Meigen.

Only one species has previously been known from North and South America and this is the common European species *spurius*. After studying a large series of specimens and comparing with typical spurius the writer has come to the conclusion that two species are present in North America. These may be separated by the following characters:

A. Eyes of male widely separated; frons about as broad as ocellar triangle; one or two pairs of rather strong frontal bristles; each harpagone produced into a rounding development on inner margin below apex (fig. 8c); females rather thickly haired with mesonotal and scutellar bristles yellow.....*latifrons* n. sp., p. 33

AA. Eyes of male very narrowly separated on the front, almost touching; frontal bristles weak; processes of inner margins of harpagones acutely pointed and situated just beyond middles (fig. 9c); females rather sparsely haired; mesonotal and scutellar bristles black .....*spurius* (Fallen), p. 36

Chalarus latifrons n. sp.

(Plate 2, figs. 8a-c)

This species is distinguished from *C. spurius* by the broad front of the male, the eyes being separated about the width of the ocellar triangle; one to two pairs of rather strong frontal bristles are present; the third antennal segment is almost twice the size of the second; each harpagone is produced into a rounding point just below the apex on inner side instead of an acute process just beyond the middle of the harpagone as in *spurius;* the harpagones are also rather thickly covered with long hairs; species slightly larger, more velvety black. The females appear to differ from *spurius* in being more thickly haired with all body bristles yellow. It appears to be largely confined to Western United States but specimens are

at hand from the East. Specimens received from Germany compare with this species so it may prove to be as extensively distributed as *spurius*.

Male. Rather densely covered with strong, dark bristles. *Head:* Frons about equal to the width at antennae, very slightly narrow in middle; face and lower one fourth to one third of front densely silvery pubescent; upper portion of front opaque black, subshining near vertex; face slightly gibbose; labellum yellowish; palpi black, enlarged and rounding at apices; antennae black, third segment comparatively large and almost oval (fig. 8a). The thorax, legs and wings are typical of the genus. Dorsum strongly bristled, pleurae almost bare, pteropleurae with a few weak hairs on anterior margins; humeri black, halteres black to slightly yellowed; femora and tibiae armed with several rows of conspicuous long hairs; legs entirely black. *Wings:* Third section of costa about four times the length of fourth; stigma light brown, filling most of third section. *Abdomen:* Opaque, rather velvety black, slightly rounding at the sides, widest at segments two to three; terga six and seven well developed and dorsal in position, seventh tergum a little more than one half the length of the eighth; sides of abdomen strongly bristled. *Hypopygium:* Eighth segment rather small, scarcely longer than the seventh; occupying the apex of the abdomen on the left side; the suture separating the eighth from the ninth is almost vertical and situated at about the middle of the apex. In *C. spurius* this suture is more to the right side. The ninth segment is rather large and elongate, occupying the right side of the apex and extending almost to base of sixth terga, from dorsal view; the ninth is not so well developed in *spurius* and extends beneath the apex of sixth tergum. The dorsal splitting of the ninth segment is plainly visible, especially in relaxed specimens; in dry material it may appear as a longitudinal ridge down the middle (fig. 8b); from ventral view the ninth segment is deeply cleft, 'U' shaped, on hind margin; the harpagones are broad and rounding, each with a small obtuse development on inner margin just below apex and another small process near base; harpagones thickly haired. Processes of ninth segment extending beyond apices of harpagones and plainly visible from ventral view (fig. 8c).

Length: body and wings 2.7-3 mm.

Female. Front slightly wider than in the male, entirely silver pubescent; not so densely haired on the dorsum; all bristles yellow except those on the dorsal portion of second antennal segment and

vertex. Halteres yellow. Base of ovipositor rounding, piercer almost twice as long as base, extending to about base of fifth abdominal segment. Otherwise like the male.

This species probably parasitizes a number of species of leafhoppers. It has been collected in sedges and tall grass meadows and flying over *Quercus vaccinifolia.* In the latter case possibly associated with Agalian leafhoppers; on willow near stream probably parasitizing *Empoasca sp?.* Taken in alfalfa at Austin, Nevada and *Ceanothus* at Sequoia National Park.

Holotype ♂ : Chiricahua Mts., Arizona, July 4, 1940 (D. E. Hardy); allotype ♀, same locality and date (R. H. Beamer). One hundred and forty-six paratypes from the following localities:

Arizona: Same locality and date as type (R. H. Beamer, D. E. Hardy); Patagonia, June 24, 1933 (R. H. Beamer).

British Columbia: Kimberly, July 29; Cranbrook, June 27.

California: Strawberry, August 8, 1929 (P. W. Oman); Palmdale, July 1940 (R. H. Beamer, D. E. Hardy); Onyx, July 23, 1940 (E. E. Kenaga); Echo, August 10, 1940 (R. H. Beamer, D. E. Hardy); Yosemite National Park, August 1, 1940 (R. H. Beamer, L. J. Lipovsky, D. E. Hardy, L. C. Kuitert); Cuyamaca Mts., S. Diego Co., Aug. 16, 1914 (J. C. Bradley); Pacific, Aug. 9, 1940 (R. H. Beamer, D. E. Hardy); Sequoia National Park, Aug. 6, 1940 (R. H. Beamer, D. E. Hardy); Mammoth Lakes, July 29, 1940 (D. E. Hardy).

Colorado: Maybell, Aug. 18, 1940 (E. E. Kenaga).

Kansas: Lawrence.

Massachusetts: Holliston, July 18 (Banks).

New Mexico: Cloudcroft, June 27, 1940 (R. H. Beamer, D. E. Hardy, L. J. Lipovsky).

Nevada: Austin, Aug. 12, 1940 (R. H. Beamer, E. E. Kenaga, D. E. Hardy); Fallon, Aug. 12, 1940 (E. E. Kenaga).

Ohio: Columbus, May 28, 1925 (R. H. Painter).

Utah: American Fork, May 28, 1940 (G. F. Knowlton, G. S. Stains); Provo, Aug. 26, 1938 (G. F. Knowlton); Joseph, June 30, 1940 (G. F. Knowlton, F. C. Harmston); Kanosh, July 12, 1940 (F. C. Harmston); Mt. Home, July 19, 1940 (G. F. Knowlton F. C. Harmston); Current Creek, June 11, 1933 (G. F. Knowlton); Price, July 21, 1940 (G. F. Knowlton, F. C. Harmston); Avon, July 9, 1939 (F. C. Harmston, G. S. Stains); Heber, May 19-Aug. 17, 1939-1940 (R. H. Beamer, G. F. Knowlton & F. C. Harmston); Logan Canyon, August 28, 1938 (G. F. Knowlton, D. E. Hardy, G. S. Stains); at light, Logan, July 9, 1940 (G. F. Knowlton, G. S. Stains).

Virginia: Falls Church, May 7, (Banks); Chain Bridge, June 23 (N. Banks).

Paratypes being returned to Utah State Agricultural College; Cambridge Museum of National History; Kansas State College and Cornell University, all other types in Snow Entomological Collection.

Charlarus spurius (Fallen)

(Plate 2, figs. 9a-g)

Cephalops spurius Fallen, 1816, Diptera Sueciae, I. Syrphici 16.

Male. Head: Ocellar bristles distinct; frontal bristles rather weak; occiput scarcely, if at all, visible from side view, usually covered by the broad hind margin of the compound eyes; compound eyes about twice as high as wide, not noticeably indented on hind margin; antennae brown to black, third segment scarcely larger than the second, reniform in shape (fig. 9a); eyes narrowly separated on the front; front scarcely as wide as median ocellus; lower one third of front silvery; upper two thirds opaque brownish. *Thorax:* Opaque to faintly shining with grayish pruinosity; dorsum of thorax, scutellum (as well as abdomen) rather thickly covered with long, pale to black pile; margins of mesonotum and scutellum with strong black bristles; pleurae chiefly bare; pteropleurae with a few weak hairs on anterior margins; propleurae with two strong yellow bristles on their anterior margins (only visible after head has been removed; humeri and halteres brown, sometimes with a faint yellowish tinge; legs brown to black, tarsi slightly yellowish, in some specimens the legs have a yellowish tinge. *Wings:* Lightly iridescent; third costal section four to six times as long as fourth, stigma filling apical two-thirds of third section; fifth section of costa shorter than third; costa extending to just beyond the end of R_{1+2}; crossvein r-m situated just slightly beyond the end of the subcostal vein; base of anal vein usually distinct, apical portion faint to entirely obliterated (fig. 9b). *Abdomen:* Opaque, faintly shining in ground color, lightly gray dusted. *Hypopygium:* The sixth abdominal segment is normal in appearance, not twisted to the left to form the basal plate of the hypopygium; on its right side, however, it apparently serves as a protective pouch for the incurved ninth segment and intromittent structures; segment seven well developed, occupying the left side of the hypopygium and about as large as eighth; eighth situated at apex slightly on left side, and together with segment seven makes up main part of genital chamber; ninth segment directed anteriorly and fits up under sixth segment, in resting position (fig. 9c); suture separat-

ing eighth from ninth is to right of apex and the ninth disappears from view near basal portion of sixth segment (fig. 9d). There is no direct line of articulation between the harpagones and ninth segment and a small acutely pointed lobe is present on inner margin of each harpagone below the apex (figs. 9c and e).

Length: body, 2-2.5 mm.; wing, 2.1-2.6 mm.

Female. Like the male, except for the broad front; the legs and halteres more consistently yellow tinged; ovipositor short thick and curved, base small, opaque; piercer extending just past posterior edge of fourth segment and polished (figs. 9f, g); sterna of abdomen are larger and more conspicuous than in the male.

Species originally described from Europe.

Type probably at Stockholm.

This species is more abundant in Eastern United States; following are the states from which it has been identified: Arizona, California, Illinois, Kansas, Massachusetts, Michigan, New Mexico, Nevada, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, South Dakota, Texas, Utah, Vermont and Virginia; also Saskatchewan and New Brunswick, Canada.

This species is said to be parasitic upon *Typhlocyba rosae* in Europe, no record has been made of this in America but its host is no doubt a species, or any number of species of small leafhoppers, such as *Typhlocyba* or *Erythroneura*. It has been taken in large numbers in willow, probably associated with *Empoasca*.

Protonephrocerus Collin

Protonephrocerus Collin, 1931, Diptera of Patagonia and South Chile, Part VI, Fasc. 2, p. 52.

Following is the original description of this genus:

"Agreeing with *Nephrocerus* in having a deep excision at middle of hind margin of each eye, a strongly bristled thorax and scutellum, and discal vein forked. Differing in having third antennal segment not reniform but similar to that of some species of Pipunculus, no cilia on prothoracic episterna, a small pteropleural bristle beneath root of wing, no prominent lobes to last abdominal sternite in female, a fringe of long hairs behind middle femora as in some species of Pipunculus, stigma darkened, and no axillary lobe to wing, the wing-margin here being formed by the anal vein."

Genotype: *Protonephrocerus chiloensis* Collin.

"Type locality: Ancud, Chiloe I., Chile."

Nephrocerus Zetterstedt

Nephrocerus Zett., 1840, Ins. Lap. 578.

The members of this genus are the largest of the Dorilaidae, they are most easily recognized by the well-developed bristles on the

scutellum and margins of the mesonotum; the large reniform third antennal segment (*scutellatus* Macquart of Europe has the third segment small); the inflated humeri and scutellum and the strongly indented posterior border of the eyes (fig. 10a). The head is nearly spherical and the ocellar bristles are lacking as in Dorilas. They are Syrphid-like in appearance, especially reminding one of members of the genus *Sphaerophoria*. They have one to two pairs of dorsocentral bristles, two bristles on postalar calli, one to two supra-alars and two posthumeral bristles; above front coxae toward the prothorax there is a row of about eight bristles; scutellum with four to eight marginal bristles.

They have been recorded as possible parasites of CICADIDAE, but the writer has been unable to confirm this; it seems highly illogical but until their life history is studied it will remain questionable. It seems probable that these may parasitize FULGORIDAE, or perhaps large CICADELLIDAE such as *Gypona*.

Genotype: *Nephrocerus lapponicus* Zetterstedt, 1840, Insecta Lapponica, p. 578.

Only two American species are known, these may be separated by the following characters:

A. Abdomen with two distinct yellow bands, one at the junction of segments two and three and the other at segments three and four; front of female very narrow above, eyes almost contiguous. *daeckei* Johnson, p. 38

AA. Abdomen indistinctly banded in male, the lateral margin yellow in female, upper half of front widely separated in both sexes. *slossonae* Johnson, p. 39

Nephrocerus daeckei Johnson

(Plate 2, figs. 10a-c)

Nephrocerus daeckei Johnson, 1903, Ent. News, XIV, 107-108.

The following is the original description of the male:

"*Male*. Face and front black, covered with a silvery white pubescence; occiput with white pubescence and hairs; antennae entirely light yellow, aristae black. Dorsal portion of the thorax a shining black; humeri, lateral margins, pleurae and scutellum, light yellow; the anterior portion of the thorax, in certain light, shows a whitish sheen; a pair of bristles on the ante-alar and post-alar callosities, and four on the scutellum. Abdomen black, shining; the posterior edge of the second and third segments narrowly margined with yellow; a small yellow spot bearing a tuft of black bristles on the sides of the first segment, the remaining segments with more or less prominent hairs and bristles especially along the sides of the posterior margins; genital portions dark yellow; halteres yellow, the knobs narrowly margined with brown above. Legs light yellow. Wings hyaline, with a very slight brownish tinge. Length, 6 mm."

Female. Head: Posterior margin of eyes strongly indented, occiput narrow; front, face and occiput silvery pubescent; antennae and mouthparts bright yellow; base of arista yellow, otherwise black; third antennal segment almost oval (fig. 10a); pile of occiput yellow; front very narrow almost contiguous on upper half. Thorax, legs and abdomen as in the male. *Wings:* Humeral crossvein vertical, third section of the costa short, about one fifth the length of the fourth section; no darkening in the stigmal area; crossvein r-m situated at about the basal one sixth of the discal cell; appendix of fourth vein (M_2) long, almost reaching to wing margin; vein M_{3+4} ending before the margin, about half way from m crossvein to margin (fig. 10b). *Genitalia:* Ovipositor short and bladelike reaching about to the end of the sixth sternum, yellow in color. Sixth sternum forming a broad plate beneath the ovipositor, this is thickly covered with short tacklike spines, especially numerous on the posterior portion (fig. 10c).

Length: body, 7-7.5 mm.; wing, 7.5-8 mm.

Type locality, Richmond Hill, L. I., New York.

Type at Boston Society of Natural History.

The writer has examined specimens from Rock City, N. Y., Cattaraugus Co., 9 June, 1915; Roxborough, Pa., VI-28-08; Richmond Hill, Long Island, July 2, 1901, (C. W. Johnson); Plummers Island, Maryland, 29-6-13 (R. C. Shannon); Franconia, New Hampshire (Mrs. Slosson).

Nephrocerus slossonae Johnson

Nephrocerus slossonae Johnson, 1915, Can. Ent. v. XLVII, 55-56.

This species differs from *daeckei* in having the abdomen entirely polished brown, without apices of segments two and three, yellowed. Pile of abdomen more erect, pale long and irregular instead of dark, slightly procumbent, shorter and more evenly placed pile as in *daeckei*. Scutellum of *slossonae* with an abundance of strong pale pile in addition to the two pairs of marginal bristles; only a few weak hairs in *daeckei*; *daeckei* with a small clump of black hairs on each coxae, above, these are yellow on *slossonae*. Third costal section of wing one third to one fourth the length of the fourth in *daeckei*, one fourth to one fifth in *slossonae*, the appendix of the fourth vein is also slightly longer in *daeckei*. Propleural brush yellow in *slossonae* with stronger brown hairs in *daeckei*.

The following is the original description of both sexes:

"*Male.* Face and front covered with silvery white tomentum, vertical triangle and occiput black, grayish pruinose, occipital orbits deeply emarginate,

mouth parts and antennae light yellow, arista black, the thickened base light yellow. Thorax, discal portion black, shining, the anterior third covered with a grayish bloom, humeri, broad lateral stripes, and the scutellum, yellow, the latter much darker than the humeri, pleura livid, a lighter area below the base of the wing bearing a small black spot, metanotum black. Abdomen black, shining, thinly covered with quite long yellow hair, with conspicuous tufts on the sides of the first segment, sides of the first and the posterior margins of the second and third segments brownish, hypopygium brown, the two large rounded glands diverted to the right, with a black, spirally coiled "flagellum" below. Legs and halteres light yellow, the long bristles at the end of the last tarsal joints four in number, posterior tibiae nearly straight, not noticeably thickened and without bristles. Wings long, narrow of nearly equal width, grayish hyaline, posterior branch of the fifth longitudinal vein scarcely reaching the margin, tegulae yellow.

Length 8 mm., wing 9 mm.

Female. Front narrow below the vertex gradually widening above the antennae, about four times its width at the vertex. Thorax similar to that of the male except that the pleura are light yellow with small black point below the base of the wing, and black spots between the coxae, disc of the scutellum and the metanotum blackish. Abdomen dark yellow, with an irregular, broad dorsal line of black constricted at the margins and covering about one-third of each of the first five segments, the fourth and fifth segments also narrowly margined posteriorly with black, sixth and seventh segments and the hooklike ovipositor entirely yellow.

Length 7.5, wing 8.5 mm."

Type locality: Bretton Woods, New Hampshire.

Type at Boston Society of Natural History.

The writer has examined specimens from the following localities: Mt. Wash., N. H.; Glen House, N. H., VI-15-14 (Johnson); Mt. Monadnock, N. H.; Bretton Woods, N. H., VI-28-13; Va. Highway Randolph, N. H., 2-VII (Banks).

Cephalosphaera Enderlein

Cephalosphaera Enderlein, 1936, Diptera Tierwelt Mitteleuropas Bd. VI, 3.

This is without a doubt the genus which Rondani described as *Prothechus* but as *Prothechus* is isogenotypic with *Verrallia* Mic, according to designated genotypes, the name is not available for use here.

This genus has been erected to contain those species of DORILAIDAE having the head nearly spherical, no ocellar or well-developed mesonotal or scutellar bristles; occiput widely developed and the fourth vein (M_{1+2}) appendiculate beyond the posterior (m) crossvein. It is split off from the old *Dorilas* (*Pipunculus*) by having the appendix on the fourth vein. Whether this should be considered a true genus or just a subgenus is somewhat questionable. On the

basis of the old (previous to Enderlein's paper [18]) generic concept in this family it certainly would not stand, but as it makes a very convenient grouping the writer is giving it generic ranking.

Genotype: *Cephalosphaera furcata* (Egger), 1860, Verh. Zoöl.-bot. Gesells Wien. 10, 347.

Only a single species (the genotype) was recognized in Europe at the time of the latest revision by Sack,[19] however, Aczel[20] has recently described a second European species, *Cephalosphaera germanica;* the genus is fairly well represented in America. From a study of the available North American types it would seem that many apparently trivial characters have been overemphasized in this group and consequently several species have been difficult to place.

KEY TO KNOWN NORTH AMERICAN SPECIES

1. Third segment of antennae short, acute to obtuse below 2
   Third segment of antennae long acuminate; if the third segment is shorter acuminate the hind tibiae of males end in an acute spur below 4
2. Pile of dorsum conspicuous and erect 3
   Mesonotal pile short, appressed; humeri yellow ..... *constricta* (Banks), p. 48
3. Femora chiefly black, only apices yellow; tarsi brown to black ..... *stricklandi* (Curran), p. 52
   Legs chiefly yellow, femora only slightly blackened medianly (México) *elegantula* (Williston), p. 50
4. Legs wholly yellow ..... *biscaynei* (Cresson), p. 45
   Only apices and bases of femora yellow, with broad black rings; tibiae usually brownish medianly 5
5. Males 6
   Females 10
6. Hind tibiae terminating in an acute spurlike point below 8
   Hind tibiae normal, without an apical development 7
7. Very large species (body 6.7 mm.; wings 7.4 mm.); crossvein r-m situated near middle of discal cell; hind trochanters with dense patches of long yellow hairs below; entirely opaque species; r-m crossvein curved ..... *maxima* n. sp., p. 50
   Rather small species (body 3.3-3.5 mm.; wings 3.8-4 mm); r-m near basal one-third to one fourth of discal cell; hind trochanters without long hairs; subshining species; r-m straight ..... *brevis* (Cresson), p. 46
8. Third section of costa about half as long as fourth; membranous area of eighth segment extends toward the base of the segment; dorsum densely white pilose ..... *tibialis* n. sp., p. 53
   Third section of costa much longer than fourth; hypopygium with a distinct apical cleft; chiefly bare species 9
9. Occiput very broad, about one third the width of the compound eyes from side view; apical cleft of hypopygium rather small but with a distinct basal cleft usually visible on right side; harpagones covered with strong hairs, broad and gently tapering, not enlarged apically ..... *appendiculata* (Cresson), p. 43
   Occiput normal, scarcely one fifth to one sixth as wide as eyes; apical cleft of hypopygium large and conspicuous, basal cleft not visible; harpagones more slender, slightly enlarged at apices and covered with thick short hairs ..... *acuminata* (Cresson), p. 42
10. Third section of costa less than half the length of fourth ..... *tibialis* n. sp., p. 53
    Third section equal or longer than fourth 11

18. 1936, Diptera Tierwelt Mitteleuropas Bd. VI, 3.
19. 1935, Die Fliegen der Palaerktischen Region, 32 Dorylaidae, Lief. 93, 1-57.
20. 1940, Zoöl. Anz., 1.12, 132, Heft 7/8, 168-169.

11. Occiput strongly swollen, puffed out in appearance.....*appendiculata* (Cresson), p. 43
Occiput normal 12
12. Large species (body 5.7-6 mm.; wing 6.4-6.7 mm.); crossvein r-m situated near middle of discal cell; third costal section but little over half the length of fourth; ovipositor base with a distinct tubercle near apex, below
maxima n. sp., p. 50
Smaller species (body 3.3-3.5 mm.; wing, 3.8-4 mm.); r-m near basal one third to one fourth of discal cell; ovipositor base normal..... 13
13. Sixth abdominal segment longer than fifth; piercer of ovipositor gently curved downward. (Western species).....*acuminata* (Cresson), p. 42
Sixth segment shorter than fifth; piercer straight. (Eastern species)
brevis (Cresson), p. 46

Cephalosphaera acuminata (Cresson)

(Plate 2, figs. 11a-d)

Pipunculus acuminatus Cresson, 1911, Trans, Amer. Ent. Soc. XXXVI, 297-298.

The females of this species are very close to *brevis* (Cresson) but the males show definite relationship to *appendiculata* (Cresson).

The following is the original description of the type female:

"Front silvery, shining black at vertex. Face silvery. Antennae with second joint black, third yellow and long white acuminate. Thorax entirely grayish pollinose, mesonotum less so in the middle, bare except for a few whitish hairs along lateral margins; scutellum convex, grayish, with minute whitish marginal hairs. Abdomen opake, grayish pollinose with bases of segments 3-5 broadly brown, which color extends more apically in the middle; sixth segment more shining. Ovipositor yellow, extending to apex of first ventral segment, slightly curved downwards; its long conical base shining black. Coxae and femora black, grayish; all joints, tibiae excepting the brown annuli, and all tarsi yellow; fore femora with two series of about three, and the middle femora with about six minute black flexor bristles; hind femora with flexor series of about four bristles. Wings hyaline, with colored stigma. Length, 3.4-4.0 mm.; wings 3.9-4.4 mm."

The following notes are added to the above description: The third costal section of wing and stigma equal to slightly longer than the fourth section; fifth section of costa shorter than third and fourth combined. Crossvein r-m situated at about basal one third of the discal cell; the appendix of the fourth vein is located about the length of the posterior crossvein from the crossvein.

Male. This is the first description of the male of this species. Eyes joined for about two thirds the length of the front, frontal triangle and face silvery; second antennal segment with long yellowish bristles below, third long acuminate (fig. 11a). Dorsocentral and marginal hairs weak, propleurae each with a conspicuous brush of long yellow hairs on hind margin. Flexor spines strong on the venter of the femora; posterior tibiae arcuate, each produced into an acute point at apex, below (fig. 11b). Abdomen faintly shining, gray dusted on sides and on apical three fourths of fifth segment. Hypo-

pygium about three fourths the length of fifth segment with a large apical depressed area; seventh sclerite scarcely visible from dorsal view; from ventral view the membranous area extends over half the length of the eighth segment on a middle line; the ninth segment is but little longer than the eighth on left side with a broad 'U' shaped cleft on hind margin extending almost half the length of the segment. Harpagones rather thick at bases, tapering apically, quite strongly curved on inner margins; apices slightly enlarged and somewhat squared; both harpogones thickly covered with short, dark bristles. Cerci moderately developed, extending well beyond apex of ninth segment (fig. 11d).

Type locality: Alamogordo, New Mexico.

Type at Philadelphia Academy of Natural Science.

The writer has studied the type series and has identified specimens from: Chiricahua Mts., Arizona, July 4, 1940 (R. H. Beamer, D. E. Hardy); Manhattan, Kansas, Sept. 27, 1931 (H. M. Smith); Glasco, Kansas, August 24, 1940 (R. H. Beamer) and Likely, B. C., July 8, 1938 (J. K. Jacob).

Cephalosphaera appendiculata (Cresson)

(Plate 2, figs. 12a-h)

Pipunculus appendiculatus Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 296-297.

The females of *appendiculata* are easily recognized by the swollen occiput, and the males by the development of the apex of the posterior tibiae and the acutely pointed harpagones.

Male. Head: Front and face silvery pubescent, occiput cinereous, lightly grayed above; third segments of antennae acuminate (fig. 12a), brown to yellowish, thickly white pubescent; base of arista yellow; bristles on under side of second segment pale, very elongate, reaching as far as tip of third segment. *Thorax:* Subshining in ground color, densely brownish pollinose above, grayed on the sides of mesonotum, pleurae and metanotum; scutellum with fine brownish marginal hairs, mesonotum covered with short rather dense pile; propleurae with a conspicuous brush of long pale hairs on the hind margins; legs chiefly yellow, coxae broad, median bands of femora brown to black; tibiae sometimes discolored medianly, apical joints of tarsi brownish; femora moderately thickened, with well-developed flexor spines and series of long yellow hairs; posterior tibiae somewhat thickened medianly, terminating in an acute spurlike projection on under sides; hind tibiae each with a series of four to five long yellow hairs arising from just above the median line on outer surface

(fig. 12b); middle tibiae with a brush of dense, yellow hairs on apical one third, below (fig. 12c); posterior basitarsi about equal to the next three subsegments in length, fifth subsegment twice as long as the fourth. *Wings:* Lightly iridescent, third section of costa equal to decidedly longer than the fourth section, stigma completely filling third section; fifth costal section much shorter than third and fourth combined; crossvein r-m situated beyond the end of the subcostal vein and beyond basal one third of the discal cell; fork of fourth vein located about the length of the last section of the fifth vein from the posterior crossvein (fig. 12h). *Abdomen:* Sides broadly rounding, widest at about segment three; subopaque to nearly shining, dusted with brown pollen; first tergum and lateral margins of other segments cinereous; fifth tergum with the gray extending dorsally in the form of two large spots interrupted with brown in the middle; sides of all segments with scattered pale pile. *Hypopygium:* Subshining, about three fourths length of the fifth segment, slightly compressed to the right and with a distinct apical cleft (fig. 12f). Ninth segment and harpagones blackish; sixth and seventh segments twisted ventrad (fig. 12e), placing this species along with *constricta* (Banks) as the most highly specialized members of the genus. From ventral view the ninth segment is about as broad as long, about two times as long as sclerotized portion of eighth on left side; apical cleft of ninth segment broadly 'U' shaped. Harpagones very broad at bases, gently tapering and acutely pointed at apices; covered with strong dark hairs. Cerci slender, reaching just beyond apex of ninth segment (fig. 12g).

Length: body, 4.4 mm.; wings, 5.5-6.2 mm.

Female. Front entirely silvery except for small shining portion at vertex; occiput very broad and puffed out, two to three times as wide as face below antennae and about one fourth as wide as compound eyes through middle from lateral view. Thorax and abdomen more cinereous, the later with a median stripe of subshining brown. Ovipositor yellowish, base elongate, piercer about equal to and tapering from its base (fig. 12d); ovipositor extending to apex of first abdominal segment.

Length: body, 3.8-4.5 mm.; wings, 5.0-5.6 mm.

Type locality: Manchester, Vermont.

Type in Boston Society of Natural History.

The writer has examined the type series and has a homotypic male from Ithaca, N. Y., May (C. W. Johnson). The species has also been identified from: Rock City, New York, Cattaragus Co.,

June 9, 1915; Pocono Lake, Pa., July 12, 1911; Balsam Mts., North Carolina, August 23, 1930; Lavender, Floyd Co., Ga., Aug. 23, 1910 (J. C. Bradley); Mt. Equinox, Vt., July 9, 1910 (Johnson); Wellfleet, Mass., Aug. 18, 1919 (Johnson); Mt. Washington, N. H., July 24, 1915 (Johnson); Sioux City, Iowa (C. H. Ainslie); Morgan, New Jersey, Aug. 7 (Wiess, West).

Cephalosphaera biscaynei (Cresson)

(Plate 3, figs. 13a-d)

Pipunculus biscaynei Cresson, 1912, Ent. News, XXIII, 453-454.

This species is easily recognized by its bright yellow legs and distinctive genitalia.

Male. Head: Face and front silvery pubescent, eyes joined for one half of the length of the front; occiput opaque black above, silvery on the sides and below; first two segments of antennae brown, third segment yellowish to brownish-yellow in ground color, covered with long white pubescence and acuminate below; third subsegment of arista swollen basally (fig. 13a). *Thorax:* Subopaque, dusted with gray to brown pollen; metanotum and pleurae cinereous; humeri black, with yellowish tinge on margins; halteres pale, knobs slightly darker than stems; propleurae each with a brush of very long conspicuous yellow hairs; only coxae of legs black, otherwise bright yellow, last tarsal subsegment brown, hind femora faintly discolored above; femora slender, spines distinctly developed on apical halves of posterior femora; hind tibiae almost straight; all basitarsi equal in length to the next three tarsal subsegments. *Wings:* Faintly iridescent, third section of costa longer than fourth, stigma completely filling third section; fifth section about equal to third and fourth combined. Crossvein r-m at about the end of the subcostal vein and at about basal one third of discal cell; ultimate section of fourth vein with a strong appendix (M_{1+2} forked beyond posterior crossvein), the appendix situated almost the length of the last section of fifth vein from the crossvein; cubital cell with a short petiole (fig. 13b). *Abdomen:* Bases of segments velvety black, apices shining in ground color dusted lightly with gray above, cinereous on the sides; segment five almost completely cinereous on apical half only narrowly interrupted by a shining median area; sides of abdomen almost straight, segments two to four about equal in length; segment five about twice as long as four. *Hypopygium* about three fourths as long as segment five, with a median depression formed by the edges of the eighth seg-

ment coming together on the dorsum and with a distinct apical keel (fig. 13d).

Length: body, 3-4 mm.; wings, 4-4.5 mm.

Female. Antennae more yellow, front silvery above antennae, shining black on upper one half (in the type female the front is mostly shining). Abdomen subshining in ground color, densely cinereous on the sides and apices of segments two to five, except for median interruption of shining black; segments one and six cinereous. Piercer of ovipositor slightly longer than its base, reaching to about middle of second abdominal segment; base somewhat rounding (fig. 13c). The description of the type states "ovipositor reaching to base of abdomen;" examination of this specimen revealed that the ovipositor was not quite this long.

Type locality: Biscayne Bay, Florida.

The writer has examined the type (♀) at Philadelphia Academy of Science, also specimens from Great Falls, Virginia, June 5 (N. Banks); Grand Rapids, Michigan, July 5, 1937 (M. S. C.); Elgin, Alabama, July 6, 1939 (D. E. Hardy) and Douglas Co., Kansas.

Cephalosphaera brevis (Cresson)

(Plate 3, figs. 14a-d)

Pipunculus brevis Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 303-304.

Pipunculus eronis Curran, 1927, Can. Ent. 59, 290. New synonymy based upon comparison of type of *brevis* with the orginal description of *eronis* and upon descriptive notes on Curran's type made by Doctor W. J. Brown.

There are no diagnostic characters in the description of *eronis* that will distinguish it. Curran separates it from *appendiculata* by "third antennal segment yellowish" leading to *eronis,* "third antennal segment brown" keying out *appendiculata;* and from *brevis* by "scutellum without hairs" equalling *brevis;* "scutellum with black and pale hairs on margin" keying out *eronis.* Examination of the type shows that *appendiculata* has the third segment yellowish and runs directly to *eronis* in Curran's key; all the specimens examined have had hairs on the scutellum; check of the width of the occiput of the type female of *eronis* indicates that it is probably the same as *brevis.*

This species is related to *acuminata* (Cresson) and *appendiculata* (Cresson); comparison of the types of *acuminata* and *brevis* brought out no characters which would separate the females conveniently, the differences in the length of the sixth abdominal segments may be due to the degree of extension and the curvature of the ovipositor may be rather slight. The males have not yet been definitely associated but the specimens described here appear to belong to this species.

The following is the original description of the type female:

"Front and face silvery, only extreme vertex shining; occiput white; second antennal joint brown, third yellow, long white acuminate. Mesonotum subopake, brownish medianly, cinereous laterally, scutellum not shining, brownish-black, without hairs; humeri black, halteres yellowish, apices of knobs brown. Pleurae and metanotum cinereous. Abdomen shining to subopake, grayish tinge at apices of segments; apical margin of first broadly white and broadly interrupted medianly; entire lateral margins of second and apical lateral angles of following segments cinereous; fifth segment longer than sixth. Ovipositor yellow, gradually tapering from the elongo-globose, cinereous base, straight or slightly curved down, extending to base of second ventral segment. Legs yellow, coxae, broad median rings on femora, and apical tarsal joints blackish; inner surface of post-femora polished; post-tibiae normal; apical and basal joints of post-tarsi in proportion 1:2; femoral spines distinct apically. Wings short hyaline, with colored stigma. Length 3.5 mm.; wings, 4.0 mm."

A series of male specimens at hand appear to belong to this species. They have not been collected with the females so the identification is not positive. The following is a description of this material.

Male. Very near to *appendiculata* (Cresson) but lacking the spurlike projection on the hind tibiae and possessing distinctive genital characters. *Head:* Third antennal segment yellowish to brown, acuminate (fig. 14a) covered with dense, white pubescence; front and face silvery; occiput cinereous below, light gray on upper part. *Thorax:* Subshining in ground color, densely brown dusted above, grayed on the sides; pleurae and metanotum cinereous; mesonotum with sparse, short hairs; propleurae with a brush of long pale hairs on hind margins; humeri black; halteres yellow; legs as in female. *Wings:* About the same as *appendiculata;* the third costal section is about equal in length to the fourth; the stigma completely filling third section; the fifth section of the costa equals the length of the third and fourth combined; crossvein r-m is situated at about the basal one third of discal cell and beyond end of the subcostal vein; fork of fourth vein located about one third the length from the posterior crossvein to the wing margin (fig. 14b). *Abdomen:* Subshining in ground color; bases of segments opaque black, apical one half to three fourths of segments brownish pollinose with rather narrow faint to distinctly gray vittae on the apical margin, more pronounced on segments one and five; lateral margins grayed; sides of abdomen slightly rounding; segment five almost twice as long as segment four. *Hypopygium:* Developed about three fourths as long as fifth segment, with segments seven, eight and nine plainly visible from dorsal view; also with a small, scarcely visible apical keel (fig. 14c).

Length: body 3.5-4 mm.; wings, 4-4.5 mm.

Type locality: Norwich, Vermont.

Type in Boston Society of Natural History.

The writer has studied the type and has examined specimens belonging apparently to this species from: Berrien Co., Stevensville, Mich., May 29, 1936 (G. Steyskal); Great Falls, Va., June 29 (Banks); 3 mi. N. Ledyard, Iowa, Aug. 7, 1928 (G. O. Hendrickson); McIntosh, Minn., Aug. 11, 1939 (R. H. Daggy); Traverse Co. (O. W. Oestlund); Ft. Snelling, July 10, 1929 (A. T. Hertig); Manhattan, Kan., Sept. 22 (R. H. Painter) and Crawford Co., Kansas, 993 ft., 1915 (R. H. Beamer). One specimen from Douglas Lake, Michigan, July 3, 1928 (M. W. Boesel) runs here but the hypopygium is more like *biscaynei* Cresson; male specimens from Aylmer, Que., Aug. 26, 1924 (C. H. Curran) fits the description except that the membranous portion of the eighth segment is expanded into an apical keel.

Cephalosphaera constricta (Banks)

(Plate 3, figs. 15a-e)

Pipunculus constrictus Banks, 1911, Trans. Am. Ent. Soc. XXXVI, 306-307.

This species is very near *elegantula* (Williston), the original description of which would seem to differ in having the mesonotum distinctly pilose and the femora somewhat blackish in the middle but as the male hypopygium was inadequately described it is difficult to know how much stress to place upon these characters.

Male. Head: Face and front silvery pubescent, eyes joined for about the length of the front; ocellar triangle shining, upper occiput dull black, sides and lower portion cinereous; antennae black, third segment acute to obtuse below (fig. 15a). *Thorax:* Mesonotum subshining in ground color, densely dusted with dull brown to black pollen, grayed on the margins; pleurae cinereous, metanotum faintly grayed, more distinctly so on upper margin; humeri bright yellow, stems of halteres yellow, knobs tinged with brownish; mesonotum almost bare, with only sparse, pale, appressed pile; propleurae with a row of long yellow hairs on anterior margins; legs, except black coxae, pale yellow, apical tarsal subsegments brownish; femora sometimes faintly disclored in the middle; femora moderately thickened, spines well developed and black; posterior tibiae slightly curved; basitarsi almost equal to next four subsegments in length. *Wings:* Hyaline, only faintly iridescent; third section of costa about equal to very slightly longer than fourth; stigma completely filling third section; fifth section about equal to third and fourth together;

crossvein r-m situated just beyond the end of subcostal vein and at about the basal one third to one fourth of discal cell; fourth vein strongly curved from r-m crossvein to posterior crossvein and also beyond the appendix; appendix of fourth vein slightly farther from posterior crossvein than the length of the last section of fifth vein (fig. 15b). *Abdomen:* Shining black, sparsely covered with short yellow hairs above; basal segments slightly constricted, abdomen widest at segments four and five. First abdominal segment longer than third, third and fourth about equal in length; fifth segment about one and one third times as long as fourth. *Hypopygium* about equal in length to fourth segment, slightly compressed to the right and with a distinct apical cleft (fig. 15d). Ninth segment and harpagones yellowish; both claspers rather slender and symmetrical (fig. 15e).

Length: body, 5.0 mm.; wings, 5.5 mm.

Female. Front entirely silvery, strongly narrowed above, near ocelli; halteres bright yellow; femora without discolorations, swollen and spinose as in male; posterior tarsi rather flattened, basitarsi about equal to next three subsegments. Ovipositor chiefly yellow, base large and somewhat swollen on under side; piercer long and slender, about two times as long as and abruptly terminating its base; reaching beyond anterior margin of second abdominal segment (fig. 15c); otherwise like the male.

Type locality: Black Mountain, North Carolina.

The writer has examined the type at the Cambridge Museum of Comparative Zoölogy and has seen specimens from the following localities.

Alabama: Tuskegee, 7-22-1930 (L. D. Tuthill).

Canada: No. 15.8 (Osten Sacken); Montreal, Quebec, June 11, 1919 (J. Quellet); Douglas Lake, Manitoba, June 15, 1925, (Criddle); Barber Dam, N. B., June 24, 1914, (F. M. McKenzie).

Florida: Ft. Augustine (Johnson).

Kansas: Douglas Co., 900 ft. May.

Minnesota: Plummer, June 3, 1938, (D. Denning).

New Hampshire: Franconia (Mrs. A. T. Slosson).

New Jersey: Pemberton, July 11, 1909; Wenonah, July 10, 1910.

North Carolina: Raleigh, IV-21-1926, (C. S. Brimley).

Oklahoma: Page, June 24, 1934, (A. E. Pritchard).

South Dakota: Canton, June 16, 1924.

Texas: Brownwood, VI-4-36, (R. H. Painter).

Cephalosphaera elegantula (Williston)

Pipunculus elegantulus Williston, 1892, Bio. Cent. Amer. III, 87.

The writer has not seen the type of this species and cannot be sure of its identity. The following is the original description:

"Frontal triangle and face black, silvery-pubescent. Antennae black; third joint silvery-pubescent, obtusely pointed below; arista black, thickened at its base. Dorsum of thorax and scutellum deep brown, moderately shining, distinctly pilose; pleurae and metanotum black, gray-pollinose. Abdomen deep black, shining, whitish, pilose; first segment and the posterior angles of the following segments opaque grey-pollinose; hypopygium large, black, moderately shining, reddish below, thinly pollinose. Legs yellow; all the femora more or less broadly blackish in the middle; distal joints of all the tarsi blackish; femora stout, on their under distal side with two rows of short black spines. Wings nearly hyaline; stigma yellowish; anterior cross-vein nearly opposite the tip of the auxiliary vein; last section of the fourth vein angulated, and with a stump; penultimate section of the fourth vein more than twice the length of the antepenultimate section. Length 4½ millim."

Type locality: México, Chilpancingo in Guerrero.

Type in British Museum.

It is very probable that *P. stricklandi* Curran should be a subspecies or variety of *elegantula*. The writer has examined a specimen from Edmonton, Alberta, July 13, 1929, (E. H. Strickland) which fits this species perfectly.

Cephalosphaera maxima n. sp.

(Plate 3, figs. 16a-f)

This species is related to *brevis* (Cresson) but is distinguished by: its much larger size; the short third costal section in the females; the r-m crossvein in both sexes situated near the middle of the discal cell and at about the apical two thirds of the third costal section; the posterior crossvein is curved in the middle and the fifth section is about equal to fourth. The female ovipositor possesses a distinct tubercle on the base below and the apex of the male hypopygium is divided into two plates by the broad longitudinal membranous area.

Male. Very large, opaque, somewhat thickly pilose species. *Head:* Eyes joined on the upper two thirds of the front, frontal triangle dull black to silvery pubescent, face silvery; bristles of second antennal segment strong, those on under side reaching almost the length of the third segment; third segment very long acuminate (fig. 16a) chiefly brown, with a yellowish tinge to the point and upper margin. *Thorax:* Brownish pruinose on the dorsum; grayed on pleurae, sides of mesonotum, scutellum, and metanotum; metanotum evenly convex with no indication of a transverse furrow;

dorsocentral and marginal hairs distinct, propleurae with a conspicuous fan of long yellow hairs on posterior margins; humeri black, halteres yellow. *Legs:* Bases and narrow apices of femora yellow, all trochanters yellowish tinged, tibiae yellow except for faint median discolorations, tarsi brownish dorsally; middle and hind trochanters with dense clumps of fine yellow hairs below; femora with several rows of long fine hairs laterally and strong flexor spines below on apical halves; posterior tibiae arcuate, no distinct apical bristles on tibiae. *Wings:* Iridescent and elongate, third costal section about equal to fourth and also about equal to length of fifth section; crossvein r-m situated well beyond the end of the subcostal vein and almost at middle of discal cell; section of fourth vein from posterior crossvein to appendix about equal in length to the posterior crossvein; section beyond the appendix strongly curved; last section of fifth vein about equal in length to posterior crossvein. *Abdomen:* Sides almost straight, segments velvety black on anterior portions, brown to grayish pruinose on posterior margins; fifth abdominal segment almost twice the length of fourth. *Hypopygium:* Just slightly shorter than fifth abdominal segment with a very extensive membranous area extending to the base of the eighth segment. Eighth segment with a longitudinal groove or indentation near the left side of dorsum. Seventh sclerite scarcely visible from dorsal view (fig. 16d). From ventral view the ninth segment is longer than wide and equal to the length of the eighth; apical cleft "U"-shaped. Harpagones broad, acute at apices and somewhat concave on inner margins. Aedeagus very long and coiled. Cerci moderately developed, rather broad (fig. 16f).

Length: body, 6.7 mm.; wings, 7.4 mm.

Female. Front about as wide as ocellar triangle, polished black on upper half, silvery below. Third costal section but little over half the length of the fourth and the r-m crossvein is situated at about apical two thirds of third section (fig. 16b). Base of ovipositor subglobose with a distinct tubercle near apical portion, below; piercer slightly longer than base (fig. 16e).

Length: body, 5.7-6 mm.; wing, 6.4-6.7 mm.

Holotype ♂ : Chiricahua Mts., Arizona, VII-4-40 (L. J. Lipovsky). Allotype and three paratype ♀ ♀ same data (D. E. Hardy and R. H. Beamer). All in the Snow Entomological Collection.

Excepting members of the NEPHROCERINAE this is the largest species known to the new world. The holotype male was taken hovering in the shade beneath an oak tree, all of the females were taken flying over a small mountain stream.

Cephalosphaera stricklandi (Curran)

(Plate 4, fig. 18a)

Pipunculus stricklandi Curran, 1927, Can. Ent. 59, 291.

This species is very near and possibly subspecific with *elegantula* (Williston); *stricklandi* apparently differs in having the femora chiefly black, only apices yellow and tarsi brown to black.

The following is the original description of the male:

"Black, the legs partly yellow; third antennal segment sharply rounded below; femora spinose beneath. Length 5.5 mm.

"*Male*. Face and front silvery gray, the eyes contiguous for half the distance above antennae; vertical triangle shining black; occiput gray pollinose, only very thinly so on upper half, the hair white. Antennae black; third segment brown, sparsely white pubescent, sharply rounded below, not at all produced.

"Mesonotum moderately yellowish-brown pollinose, the broad borders with thin grayish pollen; humeri, notopleurae and pleurae, thickly cinereous pollinose. The metanotum bears a very thin coating of pollen, the upper margin alone bearing dense grayish pollen. Mesonotum and scutellum with rather long cinereous pile; propleurae with long whitish hair.

"Coxae and femora black, the bases and broad apices of the latter reddish yellow; tibiae and basal tarsal segment reddish yellow the tarsi elsewhere brown or black. Femora gray pollinose and white pilose behind, the hair on the legs black; femora with short, spinose bristles on apical half of both edges of lower surface, the posterior femora with a row of short black bristles along the middle of the apical half in front, their tibiae with four bristles at the middle in front; all the tibiae bear an elongate brown spot at the middle on the posterior half. Posterior tibiae silvery and white haired behind.

"Wings with slight luteous tinge; stigma deep brown, entire; anterior crossvein situated slightly beyond tip of auxiliary vein, and hardly one-third the distance from base of discal cell; fourth costal section (fifth section?) about one and a half as long as either of the two preceding sections. Squamae yellowish. Halteres brown, the stem partly reddish.

"Abdomen shining black above, the sides broadly densely gray pollinose, the pollen triangularly produced on each segment posteriorly, on the fifth extending more than one-third across, the fifth segment almost one and a half as long as the fourth. Genitalia slightly inclined to right, laterally compressed, projecting a distance equal to half the length of fifth segment, with a narrowly oval apical cleft, the appendages reddish yellow. Hair sub-appressed, cinereous."

Doctor W. J. Brown has kindly compared specimens with the type and made comparative notes on this species. The posterior tibiae are simple, not produced into apical spurs; the seventh sclerite is scarcely visible from dorsal view (fig. 18a).

Type locality: Waterton, Alta., Canada.

Type in Canadian National Museum.

Specimens have been identified from: Saskatoon, Sask., Canada,

June 3, 1926 (K. M. King); Ft. St. John, B. C., June 15, 1927; Lapeer Co., Michigan, Deerfield Twp. May 30, 1937 (G. Steyskal); Ft. Collins, Colorado; Colorado University Camp, Nederland, Colo., 10,000 ft., July 3-4, 1932; also one male specimen from Clouderoft, New Mexico, June 27, 1940 (D. E. Hardy) appears to belong here.

Female. Very much like *constricta* (Banks) differing from this only in having the front not so narrowed above; humeri brown to black instead of bright yellow; mesonotum covered with short erect pile; femora chiefly black, only apices and bases yellow, tarsi brownish. Ovipositor like *constricta* in shape, base black, piercer reddish brown.

Cephalosphaera tibialis n. sp.

(Plate 3, figs. 17a-f)

This species is related to *acuminata* and *appendiculata* but is very distinct from either of these. It is distinguished by the short third costal section, the deeply cleft eighth segment, the black, short acuminate third antennal segment and the dense white pilosity on the body.

Male. Head: Junction of eyes about equal to the length of frontal triangle; frontal triangle brownish to silvery pubescent with a longitudinal raised area down the middle and a row of short hairs down each side of this carina; bristles of second antennal segment very long on under side; third segment with a fine fringe of white pubescence on apical margin; mouthparts brownish yellow; occiput narrow, about one fifth as wide as the compound eyes. *Thorax:* Dorsum rather densely white haired and thickly covered with brown pollen: pleurae and metanotum faintly grayed; humeri black, halteres yellow; propleural fan composed of numerous long white hairs. *Legs:* Chiefly black, narrow bases of hind femora, extreme apices of all, broad bases and apices of tibiae and the first three to four tarsal subsegments yellow; last two tarsal subsegments brownish; femora moderately developed with strong flexor spines on under sides near apical portions, segments faintly grayed except for the shining black venters; posterior tibiae slightly arcuate, each with a well developed spur at apex on under side (fig. 17b); femora and tibiae with abundant long white hairs on the sides; tarsal claws long, slender, yellowish white except for the black tips; pulvillae about as long as the claws. *Wings:* Fourth costal section almost twice as long as third, stigma completely filling the short third section (fig. 17c); fifth section but little longer than the fourth, crossvein r-m situated at about basal one fourth of the discal cell and at

end of subcostal vein; appendix of fourth vein situated about the length of the posterior crossvein from the crossvein; ultimate section of fourth vein sinuate. *Abdomen:* Basal portions of segments velvety black, apices subopaque, faintly grayed on the sides; sides somewhat rounding, abdomen broadest at segments three and four; the integument of the dorsum has a finely rugose appearance under high power. *Hypopygium:* About equal in length to the fifth abdominal segment; sixth segment plainly visible from dorsal view; the membranous portion of the eighth is large, extending almost to base of segment from dorsal and ventral views; eighth segment compressed to the right and somewhat pointed at apex (fig. 17e). From ventral view the ninth segment is as wide as long with a "U" shaped concavity in the middle of hind margin. The harpagones are broad at bases and gently taper into rounding apices with acute points on inner edges; inner margins slightly concave. Cerci rather elongate but very slender (fig. 17d).

Length: body, 4.2-4.6 mm.; wing, 4.8-5.2 mm.

Female. Compares in most respects to the males; the hind tibiae are simple, the third antennal segment is slightly longer acuminate and the third costal section is about one third the length of fourth. Front but little wider than ocellar triangle, chiefly opaque grayish with a subshining carina down the middle and the rows of hairs on the sides. Base of ovipositor rather elongate, with a distinct tubercle on underside near junction with piercer. Piercer almost equal to base in length, rather flattened dorsally and strongly curved upward at its apex (fig. 17f).

Holotype ♂; Ruidoso, New Mexico, June 26, 1940 (R. H. Beamer). Allotype ♀ and four paratype ♂ ♂ same data (D. E. Hardy). One ♀ paratype Fallon, Nevada, August 12, 1940 (E. E. Kenaga). All in Snow Entomological Collection.

Dorilas Meigan

Dorilas Meigen, 1800, Nouv. Class. Mouch. p. 31.
Pipunculus Latreille, 1802, Hist. Nat. Crust. et. Ins., v. 3, p. 463.
Microcera Meigen, 1803, Illiger's Mag. II, 273.
Cephalops Fallen, 1810, Specim. Dipt. Meth. p. 10.
Alloneura Rondani, 1856, Dipt. Ital. Prodr. I, 14.
Dorylas Kertesz, 1910, Cat. Dipt. VII, 368. This name was preoccupied by Dejean, 1835, Cat. de. Coleo, de la Coll. de M. de le Compt Dejean, Lief. 3, 409.

The genus as now defined includes all those *Dorilaidae* having a distinct stigma in the wing; normal venation; no vertical or ocellar bristles on the head or mesonotal or scutellar bristles on the thorax. The third segment of the antennae is usually sharply pointed below,

only in rare cases is it rounding or obtuse. The genus is divided into two subgenera by the presence or absence of a row of strong hairs on the propleurae; those species having the propleurae bare (*Eudorylas* Aczel) are being placed in the subgenus *Dorilas* (*Eudorylas*) Aczel. The following species belong in the typical *Dorilas* (*Dorilas*): *alpinus* (Cresson), *angus* (Cresson), *ater* (Meigen), *banksi* (Aczel), *fuscus* (Loew), *houghii* (Kertesz), *luteicornis* (Cresson), *pallipes* (Johnson), *trichaetus* (Malloch) and *varius* (Cresson).

Genotype: *Dorilas campestris* (Latreille) (*Pipunculus*).

Dorilas (*Eudorylas*) Aczel

Eudorylas Aczel, 1940, Zoöl. Anz. 1.12, Bd. 132, Heft 7/8, 151.

Aczel described *Eudorylas* as a new genus, but the writer prefers to consider this just a subgenus. The species are separated from *Dorilas* by the absence of the propleural fan of hairs. Because of the difficulty in checking this character and the apparent lack of consistent accompanying characters the writer does not consider this a generic character.

This subgenus contains the following species of *Dorilas: abberatus* (Hardy-Knowlton), *aequus* (Cresson), *affinis* (Cresson), *alternatus* (Cresson), *apicalis* (Hardy-Knowlton), *aquavicinus* n. sp., *atlanticus* (Hough), *bidactylus* n. sp., *caudatus* (Cresson), *cinctus* (Banks), *curtus* n. sp., *fuscitarsis* (Adams), *grandis* n. sp., *harmstoni* (Hardy-Knowlton), *huachucanus* n. sp., *kansensis* Hardy, *lasiofemoratus* (Hardy-Knowlton), *latipennis* (Banks), *lautus* n. sp., *loewii* (Kertesz), *minor* (Cresson), *montivagus* n. sp., *nevadaensis* n. sp., *nigripes* (Loew), *reipublicae* (Walker), *sabroskyi* n. sp., *stainsi* n. sp., *stigmaticus* (Malloch), *subopacus* (Loew), *tarsalis* (Banks) and *vierecki* (Malloch).

Genotype: *Eudorylas opacus* (Fallen).

Dorilas flavitarsis (Williston) and *D. willistoni* (Kertesz) are of doubtful position.

KEY TO SPECIES OF *Dorilas*

1. Humeri brown or black in ground color 2
   Humeri yellow or white in ground color 33

2. (1) Ninth segment of male very large and conspicuous, as large as eighth and plainly visible from side view; inner harpagone long, slender and curved, outer harpagone small (figs. 28b, 30d); eyes of male narrowly separated on front. Female ovipositor with large tuberculate base; third antennal segment acute, except in *grandis* females which have the front narrow 3
   Ninth segment normal, harpagones more nearly equal in size and shape; eyes of male usually contiguous on front; if base of ovipositor is tuberculate the third antennal segment is long acuminate and yellow; halteres usually yellow 8

3. (2) Femora largely black; eyes of female narrowly separated on front; front scarcely wider on upper third than width of median ocellus..... 4
Only coxae black, legs otherwise yellow; front of female wider than width of median ocellus; male hypopygium with indented area on right side and small membranous apex; ninth segment plainly visible from dorsal view; seventh sclerite large..... 5

4. (3) Hypopygium of male evenly rounded, no indentation or membranous area, ninth segment not visible from dorsal view, seventh sclerite small; third antennal segment acute; ovipositor base large, rounding, strongly tuberculate below (fig. 45d), quadrate at apex.....*huachucanus* n. sp. p. 95
Third antennal segment acuminate; ovipositor base more elongate, not square tipped or so strongly tuberculate below (fig. 41f). (Females of this species run here) .....*grandis*, n. sp., p. 90

5. (3) Females 6
Males 7

6. (5) Front broad, wider than the width of ocellar triangle; base of ovipositor swollen but not greatly tuberculate (fig. 30c).....*atlanticus* (Hough), p. 77
Front rather narrow, not as wide as ocellar triangle; base of ovipositor strongly tuberculate below (fig. 28d).....*aquavicinus* n. sp., p. 72

7. (5) Inner harpagone greatly enlarged and rounding apically (fig. 28b) with an acute process on outer edge below (fig. 28c); base of inner harpagone produced into a square topped development on inner side; outer harpagone simple; sixth sclerite with a pair of sharply pointed processes on posterior margin (fig. 28e).....*aquavicinus* n. sp. p. 72
Inner harpagone not so shaped (fig. 30d), without process on outside edge; base developed into a pair of lobes; outer harpagone more irregular, with a rounding development on outer edge; processes of sixth sclerite blunt, rather widely spaced (fig. 30e).....*atlanticus* (Hough), p. 77

8. (2) Eyes of both sexes narrowly separated on front; sixth and seventh sclerites of male well developed, occupying most of left side of hypopygium.....*grandis* n. sp. p. 90
Eyes of male contiguous for at least part of length of front; of female widely separated; sixth and seventh sclerites normal..... 9

9. (8) Legs entirely yellow; third antennal segment long, acuminate and yellow; larger species (body 3.5-4 mm)..... 10
Femora at least discolored with black; antennae usually black; smaller species 11

10. (9) Third costal section short, about one fourth the length of fourth section; stigma occupying only apical corner of third section.....*curtus* n. sp., p. 85
Third section almost equal to fourth; stigma occupying most of third section .....*vierecki* (Malloch), p. 125

11. (9) Males 12
Females 59

12. (11) Hypopygium cleft, at least apically, or with a distinct depressed area; usually compressed to the right, sometimes with an apical keel..... 13
Hypopygium without a cleft or depression, usually not compressed to the side and more symmetrical 30

13. (12) Hypopygium asymmetrical, well developed and usually as large or larger than fifth segment from lateral view; often with an apical keel..... 14
Hypopygium usually symmetrical and small, depression or cleft usually more indistinct, if with a distinct apical cleft the hypopygium is very much shorter than the fifth segment, scarcely visible from above..... 24

14. (13) Abdomen opaque or subopaque to cinereous, not shining or polished..... 15
Abdomen shining or polished, at least on posterior halves of segments, never more than bases opaque..... 17

15. (14) Abdomen subopaque to subshining, usually cinereous, velvety black only at bases of segments 19
Abdomen entirely opaque velvety brown or black, without traces of gray 16

16. (15) Third antennal segment short, rounding below; very small species, 2 mm. in length ..... *banksi* (Aczel), p. 78
Third antennal segment acute; larger species, 4-5 mm. in length .....
..... *ater* var. *velutinus* (Cresson), p. 76

17. (14) Hypopygium with apical membranous area; no apical keel; tibiae yellow; femora with not more than broad bands of black; species almost bare; smaller species, (3.2 mm. in length) ..... 17a. *varius* (Cresson) p. 122
Membranous area of hypopygium extends nearly to base of eighth segment or if apical a strong keel is present; femora and tibiae chiefly black; rather thickly haired species; larger species (4-5 mm.) 18
17a. Third antennal segment black 17b
Third antennal segment yellow ..... *varius varius* (Cresson), p. 122
17b. Hypopygium with large apical depressed area .....
..... *varius* var. *mainensis* (Cresson), p. 124
Membranous area very small, situated slightly to the left and scarcely visible from dorsal view .....
..... *varius* var. *phaethus* (Hardy-Knowlton), p. 124

18. (17) Cleft of hypopygium dorsal, depression extending toward base of segment, keel arising beneath the cleft (fig. 29d) ..... *ater* (Meigne), p. 74
Hypopygium with apical cleft or depression, keel usually arising from the middle of the depression (fig. 39d) ..... *fuscus fuscus* (Loew), p. 88

19. (15) Antennae black 20
Antennae yellow ..... ? *flavitarsis* (Williston), p. 86

20. (19) Abdomen distinctly fasciated with white or gray; bases of segments opaque, 21
Abdomen not distinctly fasciated, sometimes nearly shining 22

21. (20) Third antennal segment acute; ultimate section of fourth vein strongly sinuate; larger species, 4-5 mm. ..... *loewii* (Kertesz), p. 101
Third antennal segment acuminate; ultimate section of fourth vein nearly straight; smaller species, 2.5-3.3 mm. in length ..... 21a *cinctus* (Banks), p. 83
21a. Third section of costa about twice as long as fourth .....
..... *cinctus cinctus* (Banks), p. 83
Third section about equal to the fourth .....
..... *cinctus subtilis* n. sub. sp., p. 84

22. (20) Ultimate section of fourth vein straight 23
Ultimate section of fourth vein strongly sinuate (atypical specimens may run here) ..... *loewii* (Kertesz), p. 101

23. (22) Third antennal segment acuminate; hypopygium quadrate in outline, larger than fifth segment; moderately sized species, body 3.5-4 mm. .....
..... *caudatus caudatus* (Cresson), p. 81
Third antennal segment short, rounded below; hypopygium shorter than fifth segment; small species, 2 mm. in length ..... *banksi* (Aczel), p. 78

24. (13) Knobs of halteres black or brown 25
Knobs of halteres yellow or white. 24a ..... *varius* (Cresson), p. 122
24a. Third antennal segment black 24b
Third antennal segment yellow ..... *varius varius* (Cresson), p. 122
24a. Hypopygium with large apical cleft, plainly visible from above ....
..... *varius* var. *mainensis* (Cresson), p. 124
Hypopygium with only a small membranous apex .....
..... *varius* var. *phaethus* (Hardy-Knowlton), p. 124

25. (24) Abdomen polished, at most only bases opaque or cinereous 26
Abdomen fasciated faintly or distinctly with gray or white, or entirely opaque on first four and anterior half of fifth segments 27

26. (25) Third antennal segment long acuminate; hypopygium with basal depression on right side (fig. 61b); femora chiefly black; stigma of wing short, only filling apical portion of third costal section..... ..... *stigmaticus brachystigmaticus* (Hardy-Knowlton), p. 115
Third antennal segment acute; hypopygium with apical cleft; femora broadly yellow at bases and apices; stigma filling third costal section..... ..... *varius* (Cresson), p. 122

27. (25) Abdomen entirely opaque or but faintly fasciated, first segment only distinctly grayed; stigma short not over one half the length of the fourth costal section..... *lasiofemoratus* (Hardy-Knowlton), p. 98
Abdomen distinctly fasciated; apices of segments gray to white; stigma about equal to fourth section..... 28

28. (27) Third antennal segment black..... 29
Third antennal segment yellow (México)..... ? *flavitarsis* (Williston), p. 86

29. (28) Third segments of antennae acuminate; small species, 2.5-3.2 mm. in length ..... *cinctus* (Banks), p. 83
Third segments broadly acute; large species, body 3.8-4.2 mm.; wings 5.3-5.6 mm..... *alternatus* (Cresson), p. 69

30. (12) Antennae black 31
Antennae yellow. (México)..... ? *flavitarsis* (Williston), p. 86

31. (30) Stigma as long or longer than fourth costal section..... *nigripes* (Loew), p. 107
Stigma much shorter than fourth costal section..... 32

32. (31) Wings narrow; subcostal cell narrowed so stigma is not very distinct; apical cell strongly attenuated before wing margin (fig. 54c); ninth segment greatly developed, somewhat swollen from side view (fig. 54e), ninth about as large as eighth; cleft on hind margin narrowly 'U' shaped; harpagones acutely pointed; cerci small, scarcely extending past apices of ninth segment ..... *nevadaensis* n. sp., p. 106
Wings broad, more rounding; subcostal as well as apical cell broad at wing margin (fig. 60e); ninth segment normal, scarcely visible from side view (fig. 61g), much smaller than eighth; cleft broadly 'U' shaped; harpagones short and blunt; cerci elongate, extending to about apices of harpagones. 32a..... *stigmaticus* (Malloch), p. 114
32a. Third section of costa more than one half the length of fourth; stigma very dark and filling about three fourths of third section; r-m crossvein situated near basal one third of discal cell..... *stigmaticus stigmaticus* (Malloch), p. 114
Third costal section about one third of fourth; stigma only occupying apex of third section; r-m at basal one fifth of discal cell.... *stigmaticus brachystigmaticus* (Hardy-Knowlton), p. 115

33. (1) Males 34
Females 70

34. (33) Legs yellow, or at most with only femora slightly discolored with brownish medianly, never distinctly black ringed..... 35
At least femora of legs chiefly dark brown to black, never more than their extremities yellow..... 39

35. (34) Abdomen opaque or subopaque; apices of segments with or without gray fasciae 36
Abdomen chiefly shining or polished..... 38

36. (35) Third antennal segment long, acuminate, yellow..... 37
Third antennal segment acute, brown to black; large species, 4.5-5.3 mm. in length ..... *atlanticus* (Hough), p. 77

37. (36) Small species, 3-3.5 mm. in length; hypopygium but little developed, without apical keel ..... 37a. *minor* (Cresson), p. 103
Species 4.5-5 mm.; hypopygium larger than fifth segment and with a small apical keel (atypical specimens may run here)..... *aequus* (Cresson), p. 64

37a. Abdomen chiefly black.....*minor minor* (Cresson), p. 103
Hypopygium, sides of abdomen and venter yellow.....
.....*minor cressoni* (Johnson), p. 104

38. (35) All femora slender, not discolored with brown; first segment and lateral margins of abdomen cinereous, otherwise polished....*pallipes* (Johnson), p. 109
Posterior femora greatly thickened and somewhat discolored with brown medianly; bases of abdominal segments usually opaque black.....
.....38a. *houghii* (Kertesz), p. 92
38a. Third antennal segment yellow; third section of costa shorter than the fourth.....*houghii houghii* (Kertesz), p. 92
Antennae brown to black; third costal section longer than the fourth.....*houghii apicarinus* (Hardy-Knowlton), p. 94

39. (34) Hypopygium usually asymmetrical, with a distinct depressed area or with an apical keel 40
Hypopygium more symmetrical, without a distinct apical depression or cleft 54

40. (39) Abdomen opaque or subopaque, usually variegated with grey..... 41
Abdomen polished at least on apical three fourths of segments..... 51

41. (40) Hypopygium with a prominent apical keel usually visible; abdomen opaque brown and grey fasciated..... 42
Hypopygium without keel; abdomen subopaque, evenly brownish tinged, only faintly marked with gray except in *reipublicoe* which has the fourth segment entirely cinereous and *apicalis* which is distinctly fasciated with gray 43

42. (41) Third antennal segment yellowish; posterior femora rather slender, with weak flexor spines; third costal section and stigma much longer than the fourth section .....*aequus* (Cresson), p. 64
Antennae brownish black; post-femora greatly thickened, with strong flexor spines; third costal section much shorter than fourth.....
.....*houghii* var. *curvitibiae* (Hardy), p. 94

43. (43) Stigma equaling or distinctly longer than the fourth costal section; third section longer than fourth..... 44
Stigma but a fraction of the fourth section in length; third costal section less than one half the length of fourth; fourth abdominal segment cinereous .....*reipublicae* (Walker), p. 110

44. (43) Hypopygium with a distinct apical depressed area or cleft..... 45
Hypopygium with a distinct lateral cleft (fig. 38c) no depression apically
..... *fuscitarsus* (Adams), p. 87

45. (44) Third costal section almost twice as long as the fourth (except in *cinctus subtilis* which is distinguished by its small (hypopygium); hypopygium rather small, seldom over half the lenegth of the fifth segment, more rounded in outline 50
Third costal section about equal to the fourth in length; hypopygium large, equal or longer than the fifth segment, usually quadrate in outline..... 46

46. (45) Hypopygium rounding on the right side with the depressed area to the left; harpagones short and broad, densely haired and not produced at apices (fig. 59b).....*stainsi* n. sp., p. 113
Hypopygium usually more quadrate with an apical depressed area; harpagones not so shaped..... 47

47. (46) Hypopygium rather symmetrical with only a small membranous area at apex; outer harpagone developed into a long slender apical lobe; inner harpagone broad not produced (atypical specimens run here).....
..... *affinis* (Cresson), p. 67
Hypopygium more quadrate; harpagones differently shaped..... 48

48. (47) Harpagones rather symmetrical, tapering into slender apices which curve sharply downward (fig. 33c); hypopygium with a very large depressed area at apex ..... *caudatus* var. *discolor* (Banks), p. 82
Harpagones very asymmetrical 49

49. (48) Outer harpagone developed into two lobes apically; inner harpagone more elongate, terminating in an obtuse apex (fig. 32c); apical depression smaller ..... *bidactylus* n. sp., p. 80
Outer harpagone simple; inner produced into two lobes apically (fig. 21b) ..... *aequus* var. *argryofrons* (Hardy-Knowlton), p. 66

50. (45) Third antennal segment acuminate; abdomen only faintly fasciated, broadly rounding; harpagones symmetrical, strongly curved on outside margins, apices divergent ..... 50a. *cinctus* (Banks), p. 83
Third antennal segment short acute; abdomen distinctly gray fasciated, sides nearly straight ..... *apicalis* (Hardy-Knowlton), p. 71
50a. Third section of costa about twice the length of fourth ..... *cinctus cinctus* (Banks), p. 83
Third section about equal to fourth ..... *cinctus subtilis* n. sub. sp., p. 84

51. (40) Antennae black, acute to obtuse; wings with a brownish tinge 53
Third antennal segment yellow, long acuminate; wings hyaline, with only apical portion of stigma colored 52

52. (51) Eyes narrowly separated on the front; hypopygium one half the length of fifth segment; halteres yellow ..... *montivagus* n. sp., p. 104
Eyes contiguous for the length of front; hypopygium about equal to fifth; halteres brown to black ..... *tarsalis* (Banks), p. 120

53. (50) Halteres yellow; hypopygium well developed, with an apical cleft and vertical keel at apex ..... *fuscus* var. *nitidiventris* (Loew), p. 89
Halteres black; hypopygium not greatly developed, with a basal cleft area on the right side, no keel present ..... *harmstoni* (Hardy-Knowlton), p. 92

54. (39) Abdomen subopaque with a grayish to brownish tinge on the dorsum 55
Abdomen polished, only faintly grayed at base and on sides; stigma filling only apical one half of third costal section ..... *tarsalis* (Banks), p. 120

55. (54) Hypopygium rather small, about equal or much shorter than length of fifth segment, not so broad as width of fifth; sides of abdomen tapering posteriorly from about third segment 57
Hypopygium very large and broad, as wide as and much longer than the fifth segment; sides of abdomen straight 56

56. (55) Hypopygium two times as long as fifth; ninth segment equal in size to the eighth, tuberculate and irregular on outside margin; harpagones strongly curved downward and slightly enlarged apically ..... *lautus* n. sp., p. 99
Hypopygium not over one and one half times longer than fifth; ninth segment about half the size of eighth; harpagones straight ..... 56a. *subopacus* (Loew), p. 117
56a. Bases and apices of femora broadly yellow; tibiae yellow; third section of costa longer than fourth ..... *subopacus subopacus* (Loew), p. 117
Femora chiefly black, only narrow apices yellow; tibiae blackened medianly; third costal section shorter than fourth ..... *subopacus industrius* (Knab), p. 119

57. (55) Third section of costa about twice the length of fourth; harpagones enlarged and rounding at their apices; cleft of ninth segment 'V' shaped, no membranous area at apex ..... *sabroskyi* n. sp., p. 112
Third section about equal to fourth; harpagones not as above; cleft of ninth 'U' shaped and a distinct membranous area at apex of eighth 58

58. (57) Thorax and abdomen subshining in ground color; abdominal segments without distinct vittae; hypopygium about equal to fifth segment in length; ninth segment black; harpagones rather symmetrical and obtuse (fig. 46b) ..... *kansensis* Hardy, p. 97

Thorax and abdomen opaque brownish to gray; abdominal segments with gray vittae at apices; hypopygium shorter than fifth; ninth segment yellow; outer harpagone produced into a fingerlike projection at apex (fig. 23f).....*affinis* (Cresson), p. 67

59. (11) At least femora chiefly black, usually never more than apices yellow; median portions usually black..... 60
Legs chiefly yellow, except discolored femoral rings.....
.....*varius* var. *mainensis* (Cresson), p. 124

60. (59) Piercer of ovipositor decidedly longer than its base..... 61
Piercer not longer than base..... 65

61. (60) Third antennal segment long acuminate below..... 62
Third segment acute to obtuse..... 64

62. (61) Third costal section over one half the length of fourth; stigma filling three fourths of third section; r-m crossvein situated much beyond end of subcostal vein and beyond basal one third of discal cell, slightly behind the middle; wings more hyaline; base of ovipositor elongate; piercer slender, reaching to base of abdomen.....*abberatus* (Hardy-Knowlton), p. 63
Third costal section less than half the length of fourth; base of ovipositor usually short and globose; piercer reaching only to the posterior margin of third abdominal segment, if the piercer is more elongate the base is short and rather thick..... 63

63. (62) Ovipositor base rather elongate, piercer short, thick, slightly curved (fig. 54b) but little longer than base; wings slender, subcostal cell narrow; apical cell strongly attenuated before wing margin.....*nevadaensis* n. sp., p. 106
Ovipositor base globose; piercer long, slender, twice as long as base; wings rather broad; subcostal cell wider and apical cell widely open in wing margin .....63a. *stigmaticus* (Malloch), p. 114
63a. Third antennal segment very long acuminate (fig. 61a); stigma very short, occupying only apical corner of third costal section; fifth costal section shorter than third and fourth combined; crossvein r-m situated nearer base of discal cell.....
.....*stigmaticus brachystigmaticus* (Hardy-Knowlton), p. 115
Third antennal segment not so elongate (fig. 60a); stigma filling three fourths of third costal section; fifth costal section about equal to third and fourth combined, *stigmaticus stigmaticus* (Malloch), p. 114

64. (61) Piercer not more than twice as long as its elongate base, gradually tapering; front shining black above; stigma equaling or longer than fourth costal section .....*loewii* (Kertesz), p. 101
Piercer more slender, over three times as long as and abruptly terminating its large globose base; front silvery; stigma not over one half as long as fourth costal section.....*alternatus* (Cresson), p. 69

65. (60) Third costal section very short, less than one third length of fourth; stigma scarcely visible (fig. 54c).....*nevadaensis* n. sp., p. 106
Third costal section never much shorter than fourth section; stigma distinct, 66

66. (65) Middle femora with white hairs posteriorly; tibiae and tarsi with distinct strong hairs; hind tibiae with three very distinct long serial, bristlelike hairs on antero-dorsal surface at middle; legs chiefly black; antennae long acuminate; ovipositor reaching to apex of second abdominal segment; abdomen subopaque.....*trichaetus* (Malloch), p. 121
Not with the above combination of characters..... 67

67. (66) Abdomen almost entirely polished, cinereous only laterally; larger species, 4-5 mm. in length (association with males needed for separation).....
.....*ater* (Meigen) and *fuscus* (Loew), p.
Abdomen broad, opaque or subopaque with gray fasciae; small species, 2-3.3 mm. in length..... 68

68. (67) Front opaque; third antennal segment acute; halteres black..... ..... *cinctus subtilis* n. subsp., p. 84
Front shining black except just above antennae; third antennal segment acuminate or obtuse and rounding..... 69

69. (68) Piercer of ovipositor slender, reaching almost to base of abdomen (yet not longer than its base); third segment of antenna acuminate..... ..... *nigripes* (Loew), p. 107
Piercer of ovipositor very broad; thick and tapering third antennal segment obtuse and rounding below..... *banksi* (Aczel), p. 78

70. (33) Abdomen opaque or subopaque, cinereous to slightly shining but never polished..... 71
Abdomen polished, at most only first segment and lateral margins of abdomen cinereous..... 82

71. (70) Legs yellow, at most only femora discolored with brown medianly; third antennal segment often bright yellow..... 72
Femora chiefly black, at most only extremities yellow; third antennal segment brown or black..... 74

72. (71) Larger species (4.5-5.5 mm.); last section of fourth vein slightly curved to strongly sinuate..... 73
Small species (3.0 mm.); last section of fourth vein straight..... ..... *minor* (Cresson), p. 103

73. (72) Third antennal segment short acute..... *atlanticus* (Hough), p. 77
Third antennal segment long acuminate.....73a. *aequus* (Cresson), p. 64
73a. Third antennal segment bright yellow..... 73b
Third antennal segment black....*aequus* var. *argryofrons* (Hardy-Knowlton), p. 66
73b. Front silvery to the vertex..... .....*aequus* var. *longipes* (Hardy-Knowlton), p. 66
Front shining black on upper one third to one half..... .....*acquus aequus* (Cresson), p. 64

74. (71) Piercer distinctly longer than base, at least twice as long from base of vaginal orifice..... 75
Piercer not longer than its base; ovipositor not so developed..... 76

75. (74) Third antennal segment very long acuminate below; ovipositor reaching only to about second abdominal segment.....*cinctus subtilis* n. sub. sp., p. 84
Third antennal segment acute; ovipositor extending to base of abdomen.... .....*alternatus* (Cresson), p. 69

76. (74) Stigma completely filling the third costal section..... 77
Stigma very short, occupying only apical portion of third section; ovipositor with a tubercle beneath.....*reipublicae* (Walker), p. 110

77. (76) Ovipositor prominent, extending much beyond fifth segment; sixth tergum normal not forming a receptacle on the venter for the ovipositor.... 78, p.
Ovipositor very small, piercer not extending past base of fifth segment; margins of sixth tergum coming together on the venter to form a groove into which the ovipositor fits in resting position, sometimes the ovipositor is completely hidden..... 81

78. (77) Base of ovipositor very large, about equal to sixth segment in size from lateral view (fig. 49b); rather strongly compressed dorso-ventrally (fig. 49c).... .....*lautus* n. sp., p. 99
Ovipositor base not so developed, subglobose in shape..... 79

79. (78) Ultimate section of fourth vein straight..... 80
Ultimate section of fourth vein strongly sinuate.....*kansensis* Hardy, p. 97

80. (78) Third costal section about equal to fourth; extremities of femora yellow; only upper portion of front shining black; ovipositor base polished black, evenly rounding above (fig. 23c).....*affinis* (Cresson), p. 67

Third section one and one half times the length of fourth; only extreme apices of femora yellow; front chiefly shining black, silvery just above antennae; ovipositor base opaquqe yellowish, rather oval above and slightly tuberculate below (fig. 58c)..... *sabroskyi* n. sp., p. 112

81. (77) Ultimate section of fourth vein sinuate; ovipositor very inconspicuous, often not visible; hypopygium of male large and symmetrical..... ..... 81a. *subopacus* (Loew), p. 117

Ultimate section of fourth vein straight; ovipositor more conspicuous, not hidden; hypopygium of male with a large apical depression..... ..... *caudatus* var. *discolor* (Banks), p. 82

81a. Femora yellow basally and apically; tibiae entirely yellow.... ..... *subopacus subopacus* (Loew), p. 117

Femora only yellowed at apices; tibiae blackened medianly.. ..... *subopacus industrius* (Knab), p. 119

82. (70) Legs entirely yellow..... 83

At least femora with broad brown to black rings..... 85

83. (82) Wings extremely broad and rounding apically; third section of costa short, not over one half the length of the fourth..... *latipennis* (Banks), p. 99

Wings normal; third section of costa at least as long as the fourth..... 84

84. (83) Femora slender; piercer of ovipositor very short, with a globose base..... ..... *pallipes* (Johnson), p. 109

Femora much thickened; base of ovipositor elongate, tip of piercer reaching third abdominal segment..... *houghii* (Kertesz), p. 92

85. (82) Third antennal segment brown to black..... 86

Third antennal segment bright yellow..... 88

86. (85) Piercer of ovipositor rather short, but little if any longer than its base..... 87

Piercer slender and curved upward (fig. 24b), longer than and abruptly terminating its elongate base; base with a small tubercle below; tip of piercer extending to base of abdomen..... *alpinus* (Cresson), p. 68

87. (86) Base of ovipositor globose, piercer abruptly terminating its base; front chiefly shining ..... *angus* (Cresson), p. 71

Base of ovipositor more elongate, front silvery..... ..... *fuscus* var. *nitidiventris* (Loew), p. 89

88. (85) Costal section not over one half the length of fourth..... 89

Wings normal; third section of costa about equal to fourth..... ..... *luteicornis* (Cresson), p. 102

89. (88) Wings extremely broad and rounding apically, stigma completely fills third costal section; fifth costal section shorter than fourth; base of ovipositor simple (some may run here by having the femora discolored) ..... *lateipennis* (Banks), p. 99

Wings normal in shape; stigma occupying only the apex of third costal section; fifth section more than one and one half times the length of third and fourth combined; base of ovipositor with a tubercle below..... ..... *montivagus* n. sp., p. 104

Dorilas (*Eudorylas*) *abberatus* (Hardy-Knowlton)

(Plate 4, figs. 19a-c)

Pipunculus abberatus Hardy and Knowlton, 1939, Can. Ent. LXXI, 87.

The following is the original description:

"*Female.* Face and lower one-third of front silvery, upper two-thirds of front, vertex and upper occiput shining black; occiput cinereous below. Mouthparts chiefly brownish black, tip of labellum yellowish. Antennae black, third segment with a narrow acuminate point below (fig. 19a).

"Humeri and knobs of halteres black with cinereous pollen. Mesonotum and scutellum sub-opaque faintly shining, brownish black, lightly dusted with gray on the margins. Pleurae, metanotum, coxae and most of femora and tibiae cinereous. Trochanters with a faint yellowish tinge. Femora yellow apically; bases of tibiae yellow, their apices very narrowly so. Tarsi brownish yellow, apical one-half of claws black. Femoral and tibial spines developed but not strong. Middle coxae with two to three black hairs above near their apices, posterior trochanters with a short clump of hairs near the bases.

"First abdominal segment silvery gray, other segments brownish gray pruinose posteriorly and on the sides, opaque brownish black anteriorly. Comb of first abdominal segment black, the bristles placed in a row across the segment. Base of ovipositor somewhat globular, dark brown with gray pollen; piercer reddish brown, long and slender, reaching to the base of the abdomen (fig. 19c).

"Wings hyaline, third costal section much shorter than fourth, stigma about one-half the length of third section (fig. 19b). Ultimate section of fourth vein slightly sinuate, last section of fifth about equal to posterior crossvein; r-m crossvein beyond end of auxiliary vein and slightly behind middle of discal cell. Petiole of anal cell rather short."

Length: body, 3.4-3.6 mm.; wing, 4-4.5 mm.

Male unknown.

Type locality: Bluffdale, Utah.

Type at Utah State Agriculture College.

Added distribution: Strawberry, Utah, Aug. 4, 1938 (G. F. Knowlton, G. S. Stains); Grouse Creek, Utah, Aug. 30, 1939 (G. F. Knowlton, F. C. Harmston); and Fallon, Nevada, Aug. 12, 1940 (D. E. Hardy). Specimens from Suwanee Springs, Florida, compare in most respects with Utah material, although the third antennal segment is more acuminate and the piercer of ovipositor slightly longer.

Dorilas (*Eudorylas*) *aequus* (Cresson)

(Plate 4, figs. 20a-e)

Pipunculus aequus Cresson, 1911, Trans. Am. Ent. Soc. XXXVI, 293.

This species is related to *atlanticus* (Hough) and *houghii* (Kertesz) but is easily separated by antennal and genital characters.

Male. Head: Occiput broad, entirely cinereous; ocellar triangle shining, front and face silvery; compound eyes joined for about half the distance of the front; first two antennal segments black, second segment only weakly haired; third segment yellow, long acuminate, densely white pubescent (fig. 20a); mouth parts yellowish. *Thorax:* Mesonotum opaque, faintly shining in ground color, brownish pollinose above, gray on the margins; scutellum subshining, lightly gray dusted. Pleurae and metanotum cinereous; humeri and halteres yellow, knobs sometimes with brownish tinge, propleurae bare; legs chiefly yellow, femora with broad brownish to black bands, apices

and bases bright yellow; apical joints of tarsi brown. Femora only slightly enlarged, femoral spines weak; apical bristles of front and middle tibiae rather strong; posterior tibiae slightly arcuate. *Wings:* Faintly brownish tinged, stigma filling third costal section, third section slightly longer than the fourth, fifth costal section shorter than third and fourth together; crossvein r-m situated at, or just beyond the end of the subcostal vein, at about basal one third of discal cell; ultimate section of fourth vein (M_{1+2}) slightly curved; last section of fifth about equal to the posterior crossvein. *Abdomen:* Opaque, entire first segment and lateral margins of other segments cinereous, apical edges of segments gray, otherwise brown pollinose; fifth abdominal segment about one fourth longer than fourth segment. Hypopygium rather large, almost equal to the fifth segment as viewed from above; slightly compressed to the right, with a large apical depression extending ventrally, and a small apical projection or keel situated in the upper median portion of the depression (fig. 20b), ninth segment yellow. Almost bare species, with but few scattered hairs on thorax and abdomen.

Length: body, 5.0 mm.; wings, 5.5 mm.

Female. Lower portion of front silvery, upper portion subshining black. Apices of abdominal segments more cinereous, the fasciae broader. Legs chiefly yellow, coxae black, median portion of femora discolored brown to black. Ovipositor short, reaching just past apical margin of fourth segment; piercer yellowish to red, shorter than its base in length. Base of ovipositor blackish, large, with a yellowish gibbosity beneath. This gibbose portion folds up into a sternal cavity when in normal position; piercer broadly attached to its base (fig. 20d); otherwise like the male.

There are apparent variations in the color of the antennae and the humeri in this species. Some specimens examined have had the humeri brown to black, others have had the third antennal segment dark. These may prove to be distinct subspecies or varieties.

Type locality: Hyannisport, Mass.

Type in Boston Society of Natural History Museum.

The writer has examined the type series; also specimens from the following states: Illinois, Kansas, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, North Carolina, Rhode Island, Texas, Utah, Vermont, and Virginia, also Ontario and Quebec, Canada.

Dorilas aequus var. *argryofrons* (Hardy-Knowlton)

(Plate 4, figs. 21a-c)

Pipunculus aequus var. *argryofrons* Hardy-Knowlton, 1939, Can. Ento. LXXI

This variety differs from typical *aequus* in having the antennae entirely brown to black and the front entirely silvery. The femora are chiefly black with narrow apices and bases yellow; the ovipositor base is subglobose, piercer but little longer than the base, gently tapering (fig. 21c) and extending to the anterior margin of second abdominal segment.

A male specimen is at hand which may possibly belong with the above female although no direct association has been made; if this belongs here *argryofrons* should be considered a distinct species. The male runs near *caudatus* var. *discolor* but the hypopygium is not so quadrate in outline, the large apical cleft is situated slightly to the right side and the inner harpagone is developed into two lobes at apex (fig. 21b).

Type locality: Logan Canyon, Utah.

Type at Utah State Agricultural College.

The male discussed above is from Butlerville, Utah, Aug. 26, 1938 (G. F. Knowlton).

Dorilas aequus var. *longipes* (Hardy-Knowlton)

(Plate 4, fig. 22a)

Pipunculus aequus var. *longipes* Hardy-Knowlton, 1939, Can. Ent. LXXI, 88

Differing from the typical *aequus* in having the front of the female entirely silvery.

The following is the original description:

"*Female.* Face, front and occiput entirely silvery except for shining black spot on vertex. Mouthparts, third segment of antennae, humeri and halteres bright yellow. Second segment of antennae and broad-based arista shining black; second segment with a long yellow bristle ventrally and numerous short black bristles dorsally.

"Mesonotum and scutellum with brownish gray reclinate pubescence, ground color black; sides of abdomen sparsely covered with short yellow hairs. Trochanters and rest of legs chiefly yellow, femora and tibiae with a blackish tinge dorso-medially, femora not distinctly black ringed. Femoral spines weak, posterior tibiae slightly bowed.

"Abdomen gray pruinose on sides and anterior half of each segment. Brush of first segment composed of long pale yellow-brown hairs. Base of ovipositor dark brown elongate, as long as strongly tapering yellow ovipositor. Ovipositor reaches to about the anterior edge of the fourth abdominal segment (fig. 22a).

"Wings hyaline, third costal section and stigma longer than fourth section. Ultimate section of fourth vein straight. Last section of the fifth vein slightly longer than posterior crossvein; anal cell with but a short petiole."

Male unknown.

Type locality: Logan Canyon, Utah.

Type at Utah State Agricultural College.

Specimens at hand from the following localities appear to belong here: Raleigh, N. C., April 20, 1925 (C. S. Brimley); Pottawatomie, Kansas, April 28, 1930 (R. H. Painter) and Cold Spring Harbor, L. I., June 15, 1931 (C. H. Curran).

Dorilas (*Eudorylas*) *affinis* (Cresson)

(Plate 4, figs. 23a-f)

Pipunculus affinis Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 283.
Pipunculus globosus Cresson, 1912, Ent. News, XXIII, 453. New synonym.

The name *globosus* was applied to a female specimen which Cresson allied to *aequus* Cresson. Examination of the types showed that this was incorrectly placed; the holotype is identical with females of *affinis*.

This species is closely related to *subopacus* (Loew) but is easily separated by the reproductive structures of both sexes, the specimens of *affinis* are also slightly larger, more consistently grayed and the front of the female is silvery to the vertex instead of shining.

Male. Head: Compound eyes joined for about half the length of the front; front and face silvery, vertex shining; occiput gray pollinose, subshining in ground color; third antennal segment yellow-brown to black, very long acuminate (fig. 23a). *Thorax:* Opaque, brownish pollinose on the dorsum, gray on the margins; pleurae and metanotum cinereous; humeri yellow, propleurae bare, knobs of halteres yellow-brown to black, stems pale; extremities of femora, most of tibiae and first four tarsal subsegments yellow, femora otherwise black; median portion of tibiae discolored with brown; femora rather slender, spines weak; apical bristles of front and middle tibiae strong. *Wings:* Stigma completely filling third costal section; third section slightly longer than fourth; fifth section about equal to third and fourth together; crossvein r-m situated at, or just beyond, the end of subcostal vein and at basal one third of discal cell; ultimate section of fourth vein (M_{1+2}) straight (fig. 23b); wings slightly iridescent. *Abdomen:* Opaque brownish, cinereous on first and lateral margins of segments two to five, with faint cinereous vittae on apical margins of segments. *Hypopygium* rather small, symmetrical, but little over one half as long as fifth segment (fig. 23e). Usually there is no indication of an apical membranous area from dorsal view, however, in some specimens a small area is visible. A small portion of seventh segment is visible from dorsal

view. Ninth segment and harpagones yellowish. From ventral view a small membranous portion is visible at apex of eighth segment. The ninth is about as broad as long, with a marked indentation on outer margin near base and a shallow 'U' shaped cleft on posterior margin. Inner harpagone very broad and blunt; outer broad at base but produced apically into a long fingerlike development (fig. 23f). Cerci small.

Length: body, 3.5-4 mm.; wings, 4.4-5 mm.

Female. Front chiefly silvery, shining black near vertex; occiput moderately swollen, chiefly cinereous. Ovipositor short, piercer about equal to the base in length and extending to the apex of the fourth segment; base globose (fig. 23e).

Length: body, 3-3.8 mm.; wings, 4-5.5 mm.

Type locality: Cottage Beaulieu, Quebec.

Type in Boston Society of Natural History collection.

The writer has studied the type series; also specimens from the following states and provinces: Alberta, Arizona, British Columbia, California, Colorado, Illinois, Iowa, Kansas, Massachusetts, Michigan, Minnesota, Montreal, Missouri, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Nova Scotia, Ohio, Oklahoma, Ontario, Pennsylvania, Quebec, Utah, Virginia and Wyoming.

Dorilas (*Dorilas*) *alpinus* (Cresson)

(Plate 4, figs. 24a-b)

Pipunculus alpinus Cresson, 1911, Trans. Am. Ent. Soc. XXXVI, 306.

This is near *fuscus* var. *nitidiventris* Loew but is distinguished by its long slender ovipositor.

Female. Head: Antennae brown to black; third segment short acuminate (fig. 24a), slightly more pointed than in *fuscus* Loew; front silvery to the vertex. *Thorax:* Subshining in ground color, dusted with brown pollen dorsally, grayed on the margins and cinereous on pleurae and metanotum; dorsum of thorax rather thickly pilose, with short yellow to brown pile; dorsum of abdomen sparsely covered with pale pile; propleurae with a distinct brush of long yellow hairs; extremities of femora and most all of tibiae and tarsi yellow, legs otherwise black; median portion of tibiae often discolored with brown and last tarsal segments usually brown to black. Wings as in *fuscus* with third costal section equal to fourth; r-m crossvein at about the basal one fourth to one fifth of discal cell and last section of fourth vein sinuate. *Abdomen:* polished ex-

cept for cinereous first segment, bases and sides of second segment and lateral margins of three to five. Ovipositor elongate, piercer slender, about twice as long as its base, reaching to or near the base of the abdomen and distinctly curved; base rounding and slightly tuberculate below (fig. 24b).

Length: body, 3.7-4.5 mm.; wings, 4.2-5.0 mm.

Male unknown.

Type locality: Mt. Equinox, Vermont.

Type in Boston Society of Natural History.

The writer has examined the type series; also homotypic specimens from Mt. Washington, N. H., 2,000 ft., VII-24-1915 (C. W. Johnson). Also specimens from the following localities:

Canada: Aylmer, Que., 22-VI-1924 (C. H. Curran); Saskatoon, Sask., Aug. 16, 1939 (A. R. Brooks).

Maine: Oquossoc, VII-1922 (Johnson); Salisbury Cove, VI-23-25 (Johnson).

New Hampshire: Franconia (Mrs. Slosson); Glen House, VII-20-15 (Johnson).

Utah: Spring Hollow, Logan Canyon, Aug. 7, 1938 (D. E. Hardy, A. T. Hardy); Moab, June 4, 1940 (G. F. Knowlton, F. C. Harmston).

Dorilas (*Eudorylas*) *alternatus* (Cresson)

(Plate 4, figs. 25a-c)

Pipunculus alternatus Cresson, 1911, Trans. Am. Ent. Soc. XXXVI, 286-287.

Because of doubt concerning this species the writer prefers to quote the original description of both sexes:

"*Male.* Front brownish or grayish; face silvery; antennae brownish-black, with third joint broadly acute. Mesonotum bare, opake brown; lateral and broad anterior margins cinereous, with rudiments of a pair of median brown vittae. Scutellum opake-brown; pleurae and metanotum cinereous; halteres and humeri brown or blackish. Abdomen opake, with bases of all segments velvety-brown; apices and broad lateral angles cinereous and more shining; segments 2-4 subequal and fifth as long as third and fourth together. Hypopygium small, much shorter than fifth, with a shallow apical cleft. Legs black, grayish, with apices of femora, bases of tibiae, and tarsi, yellow; flexor and inner surfaces of post-femora polished. Wings hyaline with stigma twice the fourth section. Length, 3.8 to 4.4 mm.; wings, 5.3 to 5.6 mm.

"*Female.* Front and face silvery, former with a fine median black vitta expanding into the shining vertex; antennae with third-joint acute and minutely spiniform apically. Mesonotum opake-brown, anteriorly and laterally cinereous. Ovipositor long, straight and yellow. Similar to fig. 54[21] but longer, ex-

21. 1911, Trans. Amer. Ent. Soc., V. XXXVI. E. T. Cresson, Jr.

tending to base of abdomen, abruptly terminating its small shining black globose base. Wings hyaline with short stigma, only one-half as long as fourth section. Length, 4.2 mm.; wings, 4.5 mm."

Type locality: Cloudcroft, New Mexico.

Type at Philadelphia Academy of Natural Science.

The writer has examined the type series and compared a group of specimens with the types and found that there are apparently one or two subspecies or perhaps distinct species which run to *alternatus*. The female in the type series does not appear to belong to the same species as the males; this may, however, be an extreme case of sexual dimorphism. In the paratype female the antennae are more pointed below, broadly acute to obtuse in males; the third costal section of the wing is about one half the length of the fourth section in female, almost twice as long in the males; the stigma is shorter than third section in female and completely fills it in males.

The following additions to the description are based upon the type series: Ultimate section of fourth vein straight; apical cell very narrowly open at apex; crossvein r-m situated at basal one fourth of the discal cell; petiole of anal cell long. Hypopygium of male very short, about one fifth the length of fifth segment, with a shallow apical cleft and a depressed area on the left side (fig. 25c). Female ovipositor with a distinct tubercle at base, beneath. No brush of hairs on the propleurae.

The female specimens in the writer's collection compared in most respects with the paratype female, but have the front more shining, third costal section slightly over one half the fourth, abdomen more cinereous and the ultimate section of the fourth vein sinuate. Crossvein r-m situated nearer middle of discal cell. These are related to *abberatus* (Hardy-Knowlton) but the piercer of ovipositor is longer and the base more rounding. These specimens may belong to a subspecies or to a distinct species. The males at hand are possibly a different species from those in type series; the hypopygium is differently shaped and cleft on the right. These specimens are from a wide range of localities and their position cannot be definitely established until the males and females of *alternatus* are more surely associated.

The writer has collected in the type locality but took no specimens of this. A series of females from Chiricahua Mountains, Arizona, July 4, 1940 (R. H. Beamer, D. E. Hardy) appears to belong here.

Dorilas (*Dorilas*) *angus* (Cresson)

(Plate 4, fig. 26a)

Pipunculus angus Cresson, 1911, Trans. Am. Ent. Soc. XXXVI, 305.

This is probably not a distinct species and perhaps should be considered a subspecies of *fuscus* (Loew). It is apparently distinguished from *fuscus* var. *nitidiventris* (Loew) by the shining black front and by the shape of the ovipositor. The base of the ovipositor is more globose and the piercer more abruptly terminating its base in the typical *angus* (fig. 26a) as compared with the more elongate base and gradually tapering piercer of *fuscus nitidiventris*. The femora are also more shining black medianly in the typical *angus*. These variations have been covered in the series of *fuscus nitidiventris* (Loew) which the writer has examined but since *angus* is based upon a unique female and no males have been associated from the type locality its specific ranking is maintained; further collecting in the Southwest will clarify this matter.

Length: 3.5 mm.; wings, 5.5 mm.

Male unknown.

Type locality: Cloudcroft, New Mexico.

Type at Philadelphia Academy of Science.

The writer has a homotypic specimen from Goldstream to Downie Creek, Selkirk Mts., Br. Col., Aug. 7-11, 1905. Specimens from the following localities appear to belong to this species.

Massachusetts: Holliston, Aug. 16 (Banks).

New Jersey: Ramsey, June 16, 1916.

Collecting in the type locality has failed to produce further specimens of this, although female specimens of the typical ater-fuscus group were taken. Both male and female specimens of *fuscus* var. *nitidiventris* have been taken in similar habitats throughout the Southwest.

Dorilas (*Eudorylas*) *apicalis* (Hardy-Knowlton)

(Plate 4, figs. 27a-c)

Pipunculus apicalis Hardy-Knowlton, 1939, Can. Ento. LXXI, 88-89.

This species is related to *cinctus* (Banks) but is readily separated by its larger size; shorter, acute third antennal segment (fig. 27a); abdomen with distinct gray fasciae and the sides nearly straight, being about the same width from segment one to four; the hypopygium is very small, not over one third the length of the fifth segment.

The following is the original description with a few added notes on the wing characters:

"*Male*. Front and face silvery, front with a velvety black spot in center. Second segment of antennae black with one or two long hairs below and numerous bristles above; third segment black with white pubescence, short acute, white fringe on dorsal margin. Mouthparts yellow-brown to black. Occiput silvery gray pollinose.

"Thorax subopaque on the dorsum, silvery gray pruinose on the sides, pleurae and metanotum. Scutellum sub-shining with two pairs of rather strong bristles on the posterior margin. Mesonotum and scutellum covered with dense yellow, recumbent, microscopic pubescence. Humeri grayish yellow; knobs, of halteres black, stems yellow-brown. Coxae gray cinereous, median pair with several black bristles dorsally; trochanters subshining black, posterior pair with a small patch of short pale bristles near their bases. Femora and tibae opaque black except for yellow apices of femora and bases of tibiae. Posterior femora shining on inner edges, tarsi brownish black, basitarsi yellowed basally. Femoral bristles rather weak, tibiae and tarsi clothed with short black hairs, one long bristle on dorsal edges of posterior tibiae; tarsal brushes dense yellow, some longer hairs at the apices of tarsal segments. Segment five with three long bristles apically. Tarsal claws and pulvilli yellow, tips of claws black.

"Abdomen silver-gray pruinose on the sides, fasciated with gray along posterior margins of segments one to four, the fascia broader on the sides, the anterior half to three-fourths of each segment opaque black, fifth segment subopaque, the gray fascia extending for a short distance toward the middle from the sides; fifth segment with two indentations on each side toward the posterior margin. Hypopygium very short, subshining and with an apical cleft (fig. 27c). Lateral comb of first segment composed of four to five black bristles.

"Wing hyaline with an iridescent tinge, stigma very slightly tinged, but not distinctly brown."

Third section of costa twice the length of the fourth (fig. 27b), stigma filling only apical three fourths of section becoming very faint behind; fifth costal section about equal to the third and fourth combined. Crossvein r-m situated beyond the end of the subcostal vein and at basal one third of the discal cell; ultimate section of the fourth vein straight, last section of fifth shorter than the posterior crossvein, cubital cell with a very long petiole.

Length: body, 3.8 mm.; wings, 4.7 mm.

Type locality: Spring Hollow, Logan Canyon, Utah.

Type at Utah State Agricultural College.

Dorilas (Eudorylas) aquavicinus n. sp.

(Plate 5, figs. 28a-f)

This species belongs in the *atlanticus* group by having the ninth segment greatly enlarged, the inner harpagone strongly produced, acute third antennal segment and yellow legs. It is distinguished from other species in this complex by the unusual shape of the inner harpagone, this structure is greatly enlarged and rounded apically

and possesses an acute process on under side; the spine-like developments on the posterior margin of the sixth sclerite are also distinctive. The females are best separated from *atlanticus* by the narrower front and tuberculate ovipositor base.

Male. Head: Eyes very narrowly separated on the front, frontal triangle and face silvery pubescent, upper portion of front subshining black; antennae black, bristles of second segment strong; third antennal segment short acute (fig. 28a), densely whitish pubescent; mouthparts yellowish, palpi enlarged and rounding at the tips. *Thorax:* Subshining in ground color, densely brownish pruinose on the dorsum, grayed on the margins and pleurae; dorsocentral and marginal hairs weak, propleurae bare; metanotum cinereous with a distinct transverse furrow; humeri black, stems of halteres yellow, knobs brown to black. *Legs:* Chiefly yellow, except for blackish coxae and brownish apical two to three tarsal subsegments. Femora rather slender, ventral bristles weak; hind tibiae slightly arcuate, apical bristles of tibiae undeveloped; posterior basitarsi about equal in length to the next four subsegments; pulvilli large, almost as long as the tarsal claws. *Wings:* Third section of costa about equal to fourth, fifth section one and one half times as long as fourth; stigma dark brown, completely filling third costal section. Crossvein r-m situated near basal one third to one fourth of discal cell, ultimate section of fourth vein sinuate. *Abdomen:* Broad and rounding at the sides, widest at segments three to four. Anterior one half to three fourths of each segment brownish, apical portion and lateral margins cinereous; the gray vittae are interrupted with brown medianly; fifth segment scarcely longer than the fourth and about equal to length of the third. *Hypopygium:* Very broad and rounding, one and one half times the length of the fifth abdominal segment; seventh sclerite plainly visible from dorsal view, occupying most of the left side, from base of eighth to fifth segments; eighth segment rounding, with a depressed area above, on right side; ninth segment yellow, plainly visible from dorsal view (fig. 28f). From ventral view the broad ninth segment is seen to be much larger than the eighth and there is no apparent membranous portion; ninth segment about as broad as long, apical cleft shallow; inner harpagone greatly developed and rounding on apical half, attenuated below middle and enlarged on inner basal portion into a square lobe; on ventral portion of outside edge a strong spurlike process is present at about middle, as seen from side view (fig. 28c); outer harpagone gently tapering into an acute point at apex (fig. 28b); sixth sclerite

developed into a pair of sharply pointed projections on posterior margin (fig. 28e). These points fit just beneath the inner harpagone. Cerci small, not greatly developed.

Length: body, 4.6-4.8 mm.; wing, 4.3-5.5 mm.

Female. Eyes rather narrowly separated, front much wider, however, than the width of the median ocellus; silvery pubescent on lower one half with a shining black stripe extending from ocellar triangle about half way down the front. Base of ovipositor largely black, piercer yellowish; piercer about equal to base and sharply pointed; base of ovipositor strongly tuberculate below (fig. 28d). Otherwise like the male.

Holotype ♂ : Tajique, New Mexico, June 25, 1940 (D. E. Hardy). Allotype ♀ , same locality and date (R. H. Beamer). Seven paratypes, two ♂ ♂ , one ♀ same data as type and two males, two ♀ ♀ , Ruidoso, New Mexico, June 26, 1940 (R. H. Beamer, D. E. Hardy). These specimens were taken hovering over the water of a small mountain stream. All are in Snow Entomological Collection.

Dorilas (*Dorilas*) *ater* (Meigen)

(Plate 5, figs. 29a-f)

Pipunculus ater Meigen, 1824, Sys. Besch. der bekannten europ. Zweifl. Ins. IV, 23.
Pipunculus cingulatus Loew, 1865, Centuria vi. Berl. Ent. Zeit., IX, 176.
Pipunculus fuscus Cresson (nec Loew), 1911, Trans. Amer. Ent. Soc. XXXVI, 301.
Pipunculus horvathi Kertesz, 1907, Ann. Musei Nationalis Hungarici, V. P. 579-580.
Pipunculus townsendi Malloch, 1913, Proc. U. S. N. M. 43, 292.
Pipunculus campestris Verrall (nec Latreille), 1901, Brit. Flies, VIII, 99-103.
Pipunculus dentipes Meigen, 1838, Syst. besch. der bekannten europaischer zweifl. Ins. VII, 146.
Pipunculus dispar Zett., 1840, Ins. Lapp. 3, 579.
Pipunculus wolfi Kowarz, 1886, Wien. Ent. 3, VI, p. 152.

Specimens of *ater* from Germany were compared with the type of *cingulatus,* No. 453 in the Cambridge Museum of Comparative Zoology and found to be conspecific with it. The writer was unable to find even subspecific characters by which they could be distinguished. In any series of this species there is a certain amount of variation in the extent of opaqueness of the abdominal segments and the coloration of the legs, there was far less variation to be seen in the European and American specimens compared than exists in many local series.

This synonymy gives rise to the question, how was this species established in America? Due to their parasitic nature it would be possible for their larvae to be imported within the bodies of leafhoppers on plants or their pupae could be transported in soil or debris.

The writer has found that many of our American DORILAIDAE are

very close to European species and further comparisons may prove others to be synonymous.

This species is very near to *fuscus* (Loew) and can only be separated conveniently by the male genitalia, this is sometimes questionable and *fuscus* may actually only be a variety of *ater*.

Male. Head: Front silvery to yellow-brown pubescent, face silvery, eyes joined for about one half the length of front; occiput moderately swollen, entirely gray; antennae acute, brown to black (fig. 29a). *Thorax:* Mesonotum faintly shining, brown dusted, grayish on the margins with rather thick erect pale pile; scutellum more distinctly shining; pleruae and metanotum gray; humeri black, halteres yellow to brownish; propleurae with a brush of long yellow hairs on hind margin, pleurae otherwise bare; legs chiefly black, bases and apices of femora and tibiae and first four tarsal subsegments usually yellow; the extent of coloration on the legs varies a great deal and cannot be used as a specific character; the tibiae may be wholly yellow with only faint median discolorations or may be almost entirely black; legs clothed with long, pale hairs, femora slightly swollen, femoral spines well developed on apical portion beneath; posterior tibiae gently arcuate. *Wings:* Faintly brownish tinged, third section of costa just slightly longer or equal to fourth section, stigma filling third section; fifth section about equal to the combined third and fourth in length. Crossvein r-m at about the end of the subcostal vein and at the basal one fourth of discal cell; ultimate section of fourth vein sinuate (fig. 29b). *Abdomen:* First abdominal tergum gray, segments two to five opaque brownish black to velvety basally and brightly polished apically; the extent of opaqueness varies a great deal, in the typical condition it extends on the basal two thirds of segments two and three, basal one half of segment four and basal one fourth of segment five. All degrees of intergradation may be found from more shining to entirely opaque (variety *velutinus*), abdomen with sparse pale pile. *Hypopygium:* Greatly developed, with a large dorso-apical cleft and moderate to strong apical keel; in some specimens the keel may be much more pronounced depending upon the degree of extension. The cleft of the eighth segment extends from the apex around the keel toward the basal part of the segment, being plainly visible from above and simulating a large depressed area extending two thirds to three fourths the distance toward the base on the right side of the dorsum (fig. 29d); ninth segment and harpagones black, harpagones symmetrical, rather long and slender (fig. 29c), ninth sclerite with a 'U' shaped cleft in middle on apical margin.

Length: body, 3.5-5.0 mm.; wings, 4.5-5.6 mm.

Female: The female of this species has long been known as *horvathi* (Kertesz), the writer has definitely associated the sexes. In general they differ but slightly from the males; the eyes are broadly separated on the front, wider in the middle than the width of the front just above the antennae; front entirely silvery or with but a faint subshining line running part way down the middle from the vertex. Abdomen brightly polished; excepting the first tergum, the segments are only cinereous on the sides, no appreciable opaque fascia at the bases of the segments. Base of ovipositor rather elongate, black to yellowish apically, piercer yellow, about as long or slightly shorter than and gently tapering from its base. Piercer extending just beyond anterior margin of second abdominal segment (fig. 29f).

This is apparently the species which Cresson described as *P. fuscus* Loew.[22]

Species originally described from Europe.

Type possibly at the Paris Museum.

This species has been taken by the writer commonly associated with *Phlepsius irroratus* (Say) and *Forcipata sp.* also with Agallian leafhoppers on oak; they possibly parasitize several species.

This is one of the most common and widely distributed American as well as European species, having been recorded from the following states and Canadian provinces: Arizona, California, Georgia, Colorado, District of Columbia, Indiana, Illinois, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Ontario, Pennsylvania, Quebec, South Dakota, Texas, Vermont, Virginia and Wisconsin.

Dorilas ater var. *velutinus* (Cresson)

Pipunculus cingulatus velutinus Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 300. New Combination.

Differs from the typical *ater* in having the abdomen entirely opaque velvety brown.

Type locality: Swarthmore, Pennsylvania.

The writer has examined the type at the Philadelphia Academy of Science, also specimens from the following states: Arizona, Iowa, Kansas, Michigan, New Mexico, New York, Pennsylvania, also Alberta and Nova Scotia, Canada.

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22. 1911, Trans. Am. Ent. Soc. XXXVI, 301.

Dorilas (*Eudorylas*) *atlanticus* (Hough)

(Plate 5, figs. 30a-g)

Pipunculus atlanticus Hough, 1899, Proc. Bost. Soc. Nat. Hist. XXXIX, 80.

Large, well-defined species, widely distributed and characterized by its yellow legs, black humeri and halteres, and distinctive reproductive structures. This is one of the largest species of *Dorilas* known from the Nearctic region.

Male. Bare species. *Head:* Very large, occiput wide, densely cinereous; hind margin of compound eyes slightly arched inward; front and face silvery, mouthparts yellowish; compound eyes very narrowly separated on the upper portion of front by a thin yellowish line, this gradually widens toward the vertex; ocellar triangle shining; antennae yellow-brown, third segment short acute to obtuse below (fig. 30a), densely pale pubescent; arista black, the three segments plainly visible. *Thorax:* Mesonotum and scutellum brown pollinose, margins gray; pleurae and metanotum cinereous; propleurae without a brush of hairs; humeri and knobs of halteres brown to black, stems of halteres yellowish; legs except coxae and last tarsal segments bright yellow, femora sometimes faintly discolored medianly; femora rather slender, spines very weak; outer surfaces of femora and tibiae with a silvery sheen, produced by presence of microscopic pubescence. *Wings:* Faintly iridescent, third section of costa slightly longer to equal to the fourth section, stigma completely filling third section; fifth section shorter than third and fourth combined; third section of fourth vein (portion from r-m crossvein to m) strongly curved downward, last section of fourth vein sinuate; crossvein r-m situated at basal one third to one fourth of discal cell and at about the end of the subcostal vein (fig. 30b). *Abdomen:* Very broad, short and somewhat rounding; subopaque black in ground color; tergum of first segment and lateral margins of other segments cinereous, faintly gray on apices in typical specimens, otherwise subopaque brownish; the amount of gray on the abdomen varies a great deal, some specimens have distinct cinereous fasciae on each segment. *Hypopygium:* Greatly developed, larger than fifth segment and symmetrical in outline. Sixth segment often narrowly visible at base of hypopygium, seventh segment forming a lateral plate on left side, eighth broad and rounding with a distinct indented area or depression on the right side and a small membranous portion at apex; ninth segment yellow, plainly visible from above (fig. 30f.) From left lateral view the sixth and seventh segments are seen to be well developed and twisted under (fig. 30d);

the sixth selerite is developed into a pair of blunt lobes on posterior edge (fig. 30e); the elongate inner clasper fits in the groove between these in resting position; the left harpagone is developed into a long straplike process, which is enlarged apically; basal portion of this harpagone broad and produced into a rounded process below; this basal portion is covered with long fine hairs; the right harpagone is very differently shaped, does not have the elongate process but has a fingerlike development apically on inner margin and two small rounding lobes developed below (fig. 30d). The aedeagus is likewise very complex; the penis itself appears to be a simple shaft, ending in a sharp point; this is retracted into the phallobase; the aedeagus has well-developed supporting basal structures; these are irregular and difficult to interpret. The claspers are usually folded down into the genital chamber so unless the genitalia is extended it is seldom possible to obtain a clear view of their shape.

Length: body, 4.5-5.5 mm.; wings, 5-6.5 mm.

Female. Front silvery, not as wide as face; abdominal segments usually more distinctly gray vittate; base of ovipositor black to yellowish, enlarged and somewhat quadrate in outline; piercer yellowish to brown, but slightly longer than and abruptly terminating its base (fig. 30c.) Otherwise like the male.

Type locality: Massachusetts.

Type in the Field Museum at Chicago.

This is a rather common and widely distributed species. The writer has examined specimens from the following states and Canadian provinces: Alberta, Arizona, California, Colorado, Connecticut, Florida, Illinois, Kansas, Massachusetts, Maine, Michigan, Minnesota, New Hampshire, New Jersey, New York, North Carolina, Ohio, Ontario, Pennsylvania, Quebec, Rhode Island, South Dakota, Texas, Utah and Virginia.

Dorilas (Dorilas) banski (Aczel)

(Plate 5, figs. 31a-d)

Pipunculus banksi Aczel, 1940, Zoöl. Anz. 1.12, Bd. 132, Heft 7/8, 152.

Pipunculus terminalis Banks (nec Thompson), 1915, Psyche, Boston 22, 168. Change of name. *P. terminalis* was first proposed by Thompson 1869, Opusc. Entom. IV. p. 115. *Dorilas banksi* Hardy is just a manuscript name.

This is a very well-defined species related somewhat to *caudatus* var. *discolor* (Banks) and to *nigripes* (Loew) but is distinctly different; it is the smallest known species in the genus and one of the smallest in the family.

Male. Chiefly brown to black species, almost entirely devoid of

pile. *Head:* Antennae brown to black, third segment small, bluntly rounding below (fig. 31a); front opaque brown with a small shining triangular area extending up from between the antennae; face faintly gray dusted; mouthparts yellowish; eyes closely joined on upper two thirds of front, right up to the ocellar triangle; occiput gray on lower portion, opaque brownish to subshining black on upper portion. *Thorax:* Subshining in ground color, entirely covered with dense brown pruinosity; sternopleurae chiefly subshining; metanotum faintly grayish; humeri black, halteres yellow-brown; propleurae with three or four long yellow hairs on hind margins; legs mostly blackish, sometimes faintly yellowish tinged; posterior tibiae slightly arcuate; femoral spines very weak only a few pairs discernable near the apices. *Wings:* Faintly iridescent; third section of costa elongate, almost three times the length of the fourth section; stigma almost completely filling third section; fifth costal section shorter than third and fourth combined, about equal to the third section in length; crossvein r-m at about the basal one third of the discal cell, last section of fourth vein (M_{1+2}) but slightly curved, the apical cell narrowing very gradually from the posterior crossvein to the wing margin. Posterior crossvein about equal to the last section of the fifth vein in length (fig. 31b). *Abdomen:* Somewhat rounding on the sides, broadest at segments three to four; velvety brown to black, except the apical two thirds of segment five and the hypopygium which are subshining to nearly polished; sparsely dusted with microscopic scales. Segments one to four about equal in length; segment five is almost twice as long as four. *Hypopygium* almost quadrate in outline with a large apical cleft, almost as long as the fifth segment from dorsal view (fig. 31d); ninth segment black, harpagones yellowish; harpagones apparently symmetrical.

Length: body 2-2.5 mm.; wings, 2.8-3.2 mm.

Female. Face narrow, silvery pubescent with a thin dull black line down the center; mouthparts yellowish. Front slightly convex in the middle just above the antennae, shining black with a narrow strip of silvery pollen along the inner margins of the eyes. Extreme apices of femora and tibiae, and bases of tibiae yellow. Abdomen opaque brownish gray pollinose, more grayed on the sides, segment six slightly shining. Base of ovipositor brownish black, merging into yellow-brown as the ovipositor tapers down; piercer of ovipositor reaches to the anterior edge of segment three in the specimens at hand, but the posterior portion of the abdomen is some-

what curved under. Ovipositor stout and broadly tapering, piercer about equal to base in length (fig. 31c).

Length: body, 2.5-3 mm.; wing, 4 mm.

Type locality: Falls Church, Virginia.

Type in Cambridge Museum of Comparative Zoölogy.

The writer has studied the type material and has homotypes from: Falls Church, Va., May 23-Aug. 2 (Nathan Banks); Great Falls, Va., June 16-29-Sept. 24 (N. Banks); Logan Canyon, Utah, Aug. 7-Sept. 4, 1938 (D. E. Hardy, A. T. Hardy, G. S. Stains). Specimens have also been examined from the following localities: Sequoia National Park, California, Aug. 6, 1940 (R. H. Beamer, D. E. Hardy, E. E. Kenaga); Sunnyside Canyon, Huachuca Mts., Arizona, July 9, 1940 (R. H. Beamer, E. E. Kenaga, D. E. Hardy); Sandpoint, Idaho, July 3, 1917 (H. G. Dyar); Vinton, Ohio, July 5-12, 1900 (Jas. S. Hine); Kentville, N. S., July 28, 1924 (R. P. Gorham).

Dorilas (*Eudorylas*) *bidactylus* n. sp.

(Plate 5, figs. 32a-c)

This species is related to *caudatus* var. *discolor* but the male hypopygium is more rounding, not so quadrate, apical depression not so large. The harpagones are much different in shape, the outer one being developed into two lobes apically and the inner more elongated, terminating in an obtuse apex. Species more consistently black.

Male. Almost completely bare species. *Head:* Eyes joined on upper two thirds of front; frontal triangle and face silvery pubescent; antennae black, bristles of second segment rather weak; third segment acuminate below (fig. 32a). *Thorax:* Shining black in ground color, dusted rather thickly with brown on the top of mesonotum; pleurae and sides of mesonotum grayish; scutellum largely shining; metanotum gray, rather evenly convex, with but a faint indication of a transverse furrow; humeri yellow on upper halves; stems of halteres yellowish tinged, knobs black; dorsocentral hairs very weak, propleurae bare; legs chiefly black, bases of tibiae yellowish; femora slender, femoral bristles weak, moderately developed on the venters. *Wings:* Lightly iridescent; third section of costa slightly longer than the fourth; fifth section about three fourths the length of third and fourth combined; crossvein r-m situated just beyond end of subcostal vein and at about basal one third of the discal cell; ultimate section of fourth vein straight, last section of fifth about equal in

length to the posterior crossvein. *Abdomen:* Sides almost straight, slightly wider at segments two to four; thickly brownish pruinose on the dorsum, grayed on the sides. *Hypopygium:* Subshining, about one and one fourth times the length of fifth abdominal segment; somewhat quadrate in outline but more symmetrical than in *caudatus*. Seventh sclerite plainly visible from dorsal view; eighth segment almost as long as broad, with a conspicuous apical depressed area slightly to the left side (fig. 32b). From ventral view the membranous area of the eighth segment is seen to be rather small; the ninth segment is a little longer than wide, with a distinct indentation on outside margin near base and a small groove on both sides near apex; the cleft on hind margin of the ninth is 'U' shaped. Harpagones broad at bases, the outer one rather short and produced apically into a pair of blunt lobes; the inner harpagone is longer, gently tapered into an obtuse apex, with a square niche on outer margin just below apex (fig. 32c). Cerci moderate in size extending just beyond the posterior margin of ninth segment.

Length: body, 3.4 mm.; wing, 3.6 mm.

Female unknown.

Holotype ♂: Chiricahua Mts., Arizona, July 4, 1940 (D. E. Hardy). Paratypes: three ♂♂, same locality and date as type (R. H. Beamer, D. E. Hardy); one ♂, Duck Lk., Conquest, N. Y., Aug. 5, 1921 (Shannon) and one ♂, Bath, Michigan, June 6, 1940 (C. W. Sabrosky).

One paratype returned to Cornell University, and one to Michigan State College. All other types in Snow Entomological Collection.

Dorilas (Eudorylas) caudatus (Cresson)

(Plates 5-6, figs. 33a-c)

Pipunculus caudatus Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 289-290.

Male. Head: Front and face silvery pubescent; that portion of front below ocelli shining black; eyes joined for about the length of the front above antennae; upper occiput dull gray, sides and lower portion cinereous; antennae black; third segment acuminate. *Thorax:* Shining in ground color, thickly covered with brownish to gray pollen, metanotum and pleurae cinereous; humeri and knobs of halteres black; apices of femora and tibiae and bases of tibiae yellow; first four tarsal subsegments yellowish; fifth subsegment brown; trochanters sometimes yellowish tinged; femoral spines rather well developed on hind legs; apical bristles of front and

middle tibiae strong. *Wings:* Faintly iridescent; third section of costa slightly longer than the fourth, stigma completely filling third section; fifth section shorter than third and fourth combined; crossvein r-m at about the end of the subcostal vein and at basal one third of discal cell; last section of fourth vein straight, slightly longer than third section of that vein (fig. 33a). *Abdomen:* Subshining to opaque brownish, lateral margins of segments only faintly grayed, no vittae on the dorsum other than on segment one; sides of abdomen slightly rounded, widest at segment three. *Hypopygium* large, quadrate in outline, as long to longer than fifth segment from dorsal view and with a rather large apical depression; seventh tergum plainly visible from above (fig. 33b); ninth segment brownish yellow, elongated, longer than wide and longer than eighth segment; apical cleft 'U' shaped. Harpagones yellowish, broad, rather symmetrical, elongated into slender fingerlike lobes apically; the apical portions bend downward in normal position (fig. 33c); cerci small.

Length: body, 3.5 mm.; wings, 3.8 mm.

Female unknown; very possibly is known as some other species. It has not yet been associated with the male.

Type locality: Sea Cliff, Long Island.

Type in Cambridge Museum of Comparative Zoölogy.

The writer has studied the type and has examined specimens from the following states and provinces: British Columbia, Massachusetts, Maine, New Jersey, New York, Ohio, Ontario, Quebec, Virginia.

Dorilas caudatus var. *discolor* (Banks)

(Plate 6, figs. 34a-b)

Pipunculus discolor Banks, 1911, Trans. Amer. Ent. Soc. XXXVI, 290. New combination.

Examination of the types of *caudatus* and *discolor* disclosed that these are not distinct species but that only variety differences exist in the two. The name *caudatus* is being used as the typical form by having page priority.

The variety *discolor* differs in having the humeri and bases of femora yellow; abdomen subshining, apices of segments sometimes lightly cinereous. The writer is unable to find other characters which will separate these.

Length: body, 3.5-4.5 mm.; wings, 4.5-5 mm.

Female. Specimens of this sex run to *subopacus* (Loew) and are sometimes difficult to separate unless accompanied by the males. They are best distinguished by the wing venation; ultimate section

of fourth vein straight. The specimens are of slightly larger size, the antennae are more distinctly yellowed and slightly more elongate pointed below (fig. 34a). The sixth tergum curves around the sides of the abdomen and the margins come together on the venter as in *subopacus:* the base is small and globose; the piercer very short, extending to hind margin of fifth segment (fig. 34b); none of the specimens examined had the ovipositor folded into the groove on the venter.

Type locality: Ithaca, New York.

Type in Cambridge Museum of Comparative Zoölogy.

This variety is widely distributed, the writer has examined the type series, also specimens from the following states: Arizona, California, Iowa, Kansas, Massachusetts, Michigan, New Jersey, New Mexico, New York, Ohio, Pennsylvania, Utah and Virginia.

Dorilas (*Eudorylas*) *cinctus* (Banks)

(Plate 6, figs. 35a-d)

Pipunculus cinctus Banks, 1915, Psyche, XV, 169.

This species is related to *caudatus* var. *discolor* (Banks) but can be separated by its smaller size, longer third costal section of wing, smaller hypopygium and more distinctly fasciated abdominal segments.

Male. Antennae brown to black; third segment acuminate with a rather long point below (fig. 35a); face and front silvery; eyes joined for about the length of the front. *Thorax:* Mesonotum brownish pollinose, gray on the margins; pleurae and metanotum gray; humeri yellowish brown, more brownish medially and yellowish around the margin (because of this the species is keyed in two different parts of the key); halteres brown with pale stems; femora chiefly black, apices yellow; tibiae yellow with dark discolorations; first four subsegments of tarsi yellow; apical bristles of front and middle tibiae strong and black. *Wings:* Third costal section over twice as long as fourth, stigma completely filling the long third section; fifth section slightly longer than third and fourth together; crossvein r-m beyond end of subcostal vein and at basal one third of discal cell (fig. 35b); ultimate section of fourth vein straight; petiole of cubital cell long. *Abdomen:* Basal halves of segments velvety opaque, apical halves subshining to cinereous, usually rather distinctly fasciated; sides of abdomen broadly rounding, widest at segments two and three and strongly tapering toward the apex. *Hypopygium:* But little over one half the length of the

fifth segment, slightly compressed to the right and with an apical cleft (fig. 35d). From ventral view the membranous area extends more than half the length of eighth segment, sclerotized portion on left side extending to apex; ninth segment as broad as long, with a deep 'V' shaped cleft on hind margin; cleft extending two thirds the length of the segment, on a middle line. Harpagones irregular but rather symmetrical, strongly curved on both margins and greatly narrowed apically. Cerci well developed, extending just beyond apex of ninth segment (fig. 35c).

Length: body, 2.5-3.2 mm.; wing, 3-4 mm.

Female unknown.

Type locality: Falls Church, Virginia.

The writer has examined the type (No. 13554 Cambridge Museum) and has a series of homotypic specimens from Raleigh, North Carolina, September 1, 1926 (C. S. Brimley); Jacksonville, Florida, November 3, 1911 and Griffin, Georgia, Aug. 12, 1939 (R. H. Beamer).

Dorilas cinctus subtilis n. subsp.

(Plate 6. figs. 36a-b)

Because of the structural similarities this is considered a subspecies of *cinctus*. It is distinguished by having the third section of costa about equal in length to the fourth, instead of approximately twice as long. Hypopygium with a more extensive membranous area, as seen from ventral view, the membrane being separated from the ninth segment by just a narrow band of the sclerite on posterior margin. The ninth segment has a small indentation on outer margin near base and the cleft on hind margin is broadly 'U' shaped and not so deep as in typical *cinctus*. The harpagones are more curved and more elongated and the apices are slightly enlarged (fig. 36a). The humeri are typically yellow but may be yellow-brown to blackish in some specimens.

Length: body, 3.3 mm.; wing, 3.6 mm.

Female. Related to *affinis* but different in that the upper two thirds of the front is chiefly shining black; the piercer of ovipositor is long and slender, produced longer than its base; base small and rounding with a distinct tubercle below (fig. 36b).

Holotype ♂: Chiricahua Mts., Arizona, July 4, 1940 (R. H. Beamer). Allotype ♀, same locality and date (D. E. Hardy). Paratypes: seventeen ♂♂, one ♀, same locality and date as type (R. H. Beamer, D. E. Hardy); five ♂♂, three ♀♀, Ruidoso, New Mexico, June 26, 1940 (R. H. Beamer, D. E. Hardy); one ♂,

five ♀ ♀, Sunnyside Canyon, Huachuca Mts., Arizona, Aug. 24, 1940 (R. H. Beamer, E. E. Kenaga, D. E. Hardy); one ♂, Pingree Park, Colorado, July 11, 1937 (C. L. Johnston) and one ♂, Glasco, Kansas, Aug., 24, 1940 (R. H. Beamer). All in Snow Entomological Collection.

Dorilas (*Eudorylas*) *curtus* n. sp.

(Plate 6, figs. 37a-e)

This species is related to *vierecki* (Malloch) in having the legs and third antennal segment yellow, also in having the hypopygium with a large apical depressed area. It is distinguished by the short third costal section and minute stigma in the wings; by the larger membranous portion of eighth segment, with only a narrow band of the sclerite on the posterior margin of that segment; cleft of ninth segment not so deep and harpagones not so broad apically; species slightly smaller (compare scale drawings [figs. 37e and 67f] of hypopygia from ventral view).

Male. Moderately sized, almost entirely bare species. *Head:* Eyes and lower portion of front silvery pubescent, upper portion of front shining black; first two segments of antennae black; bristles of second segment rather strong; third segment long acuminate below (fig. 37a), bright yellow in color; first two sections of arista faintly yellowed; mouthparts yellow; palpi bluntly rounding apically. *Thorax:* Shining black in ground color, rather thickly gray dusted on sides, lightly so on the dorsum; metanotum cinereous, evenly convex, with no indication of a transverse furrow; dorsocentral and marginal hairs very weak, propleurae bare; humeri black, halteres yellow. *Legs:* Entirely yellow except for blackish coxae and brownish yellow apical subsegments of tarsi. Femora rather slender, ventral spines well developed on apical halves; hind tibiae slightly arcuate, apical bristles very weak; posterior basitarsi about equal to the remaining subsegments of the tarsi. *Wings:* Lightly iridescent; third section of costa slightly more than one fourth the length of the fourth section (fig. 37b); fifth section about equal to third and fourth combined; stigma very small, occupying only the apex of the third section; crossvein r-m situated at about the end of subcostal vein and about basal one third of discal cell; ultimate section of fourth vein sinuate, last section of fifth about equal to length of posterior crossvein. *Abdomen:* Shining black in ground color, faintly dusted with gray on the dorsum, more cinereous on first tergum and on lateral margins; sides slightly rounding, widest at segments three to four. *Hypopygium:* About three

fourths the length of fifth abdominal segment, compressed to the right and possessing a large apical membranous area. The seventh segment is scarcely visible from dorsal view, occupying a very small portion at the base of the eighth segment on the left side (fig. 37d). From ventral view the membranous area is seen to be very extensive, occupying the larger portion of the eighth segment, with only a narrow band of the sclerite separating it from the ninth segment. Ninth segment about as broad as long, apical cleft 'V' shaped, extending about one half the length of the segment on a middle line. Harpagones with broad bases but tapering posteriorly, obtusely pointed on inner apices. Cerci moderately developed, extending beyond hind margin of ninth segment (fig. 37e).

Length: body, 3.5-3.8 mm.; wing, 3.8-4 mm.

Female unknown.

Holotype ♂: Chiricahua Mts., Ariz., July 4, 1940 (D. E. Hardy). Paratypes: two ♂ ♂, same locality and date as type (R. H. Beamer, D. E. Hardy). All in Snow Entomological Collection.

Dorilas flavitarsis (Williston)

Pipunculus flavitarsis Williston, 1892, Bio. Cent. Amer. III, 87.

The original description does not include sufficient diagnostic characters to distinguish this species clearly; until the type is studied its position will probably remain questionable.

Following is the original description:

"Face and frontal triangle black, silvery-pubescent. Antennae black; third joint in large part yellow, acute, but not produced below; arista black. Thorax black; dorsum and scutellum brownish pollinose; pleurae grey-pollinose. Abdomen blackish-brown, suboqaque; the first segment and the hind angles of the following segments opaque grey. Legs black; extreme tip of the femora, tibiae for the greater part, and the tarsi, save their tip, yellow; femora not markedly thickened nor with spines below. Wings nearly hyaline; stigma yellow; anterior crossvein situated beyond the tip of the auxiliary vein; last section of the fourth vein sinuous, without stump; penultimate section of the fourth vein scarcely twice the length of the antepenultimate section. Length 4 millim."

Type locality: México, Chilpancingo in Guerrero.

Type in British Museum.

Dorilas (*Eudorylas*) *fuscitarsis* (Adams)

(Plate 6, figs. 38a-c)

Pipunculus fuscitarsis Adams, 1903, Dipterological Contributions. Kansas University Science Bulletin, II, 36.

The following is a redescription of the type:

This species is related to *caudatus* var. *discolor* (Banks) but may be separated by the elongate third costal section of the wing and the laterad depression of the hypopygium.

Male. Almost bare species, nearly devoid of pile. *Head:* Eyes joined for the greater length of the front, face and front silvery, occiput cinereous; antennae brown to black, third segment short acuminate (fig. 38a), basal two sections of arista yellowish, otherwise black, (antennae broken on type). *Thorax:* Mesonotum subshining black in ground color, densely brown pollinose, grayish on the margins; pleurae and metanotum cinereous, propleurae bare; humeri yellow, halteres brown to black, stems pale; legs chiefly brown to black, apices of femora and tibiae, bases of tibiae and sometimes extreme bases of femora yellow; tarsi brown in type; in other specimens the tibiae and tarsi are chiefly yellow; legs uniformly gray pollinose; femoral spines weak, tibiae almost straight. *Wings*: Slightly iridescent tinged; third section of costa much longer than fourth in length (scarcely longer in some specimens examined), stigma completely filling third section, dark brown in color; fifth section about equal to third and fourth combined; crossvein r-m situated beyond the end of the subcostal vein and just beyond the basal one third of discal cell; last section of fourth vein faintly curved; cubital cell with a long petiole (fig. 38b). *Abdomen:* Entirely opaque brown, except grayed first segment, in the type; other specimens have light gray vittae on the apices of each segment extending inward from lateral margins but broadly interrupted with brown medianly. *Hypopygium* subshining black, compressed to the right and with a distinct cleft on the right side formed by the coming together of the eighth and ninth segments; hypopygium about as long as fifth segment (fig. 38c); ninth segment chiefly black, folded inward on the right side, the basal portion visible from a dorsal view, harpagones yellow.

Length: body, 4.5 mm.; wing, 5.2 mm.

The female has not been definitely associated. It will probably fit near *alternatus*.

Type locality: Magdalena Mountains, New Mexico.

Type in Snow Entomological Collection.

Added distribution: Indian Creek, Utah, July 27, 1938 (G. F. Knowlton, F. C. Harmston); Logan Canyon, Utah, Aug. 10, 1938 (D. E. Hardy, G. S. Stains); Spring Hollow, Logan Canyon, Utah, Aug. 7, 1938 (D. E. Hardy, A. T. Hardy); Sunnyside Canyon, Huachuca Mts., Arizona, July 9, 1940 (R. H. Beamer, E. E. Kenaga, D. E. Hardy); Onyx, California, July 23, 1940 (R. H. Beamer); Camerons Pass, Colo., August 20, 1940 (R. H. Beamer) and Cloudcroft, New Mexico, June 20, 1902.

Dorilas (*Dorylas*) *fuscus* (Loew)

(Plate 6, figs. 39a-d)

Pipunculus fuscus Loew, 1865, Centuria VI. Berliner Ento. Zeitschrift, IX, 175.
Pipunculus cingulatus Cresson (nec Loew), 1911, Trans. Amer. Ent. Soc. XXXVI, 299-300. New synonymy.

The species described by Cresson as *cingulatus* Loew was actually *fuscus,* his figure of the male genitalia clearly points this out.

The only dependable criterion for separating *fuscus* (Loew) from *ater* (Meigen) is by the male genitalia; these structures are quite distinctive but may show some intergradation.

Male. Chiefly black species with erect pale pile on mesonotum and sparsely distributed yellow hairs on abdomen. *Head:* Eyes joined on upper portion of front for about the length of the frontal triangle; front grayish to brown pubescent, face silvery; mouthparts yellow; antennae brown to black, third segment acute (fig. 39a); occiput rather narrow especially above, lightly grayed on upper portion, cinereous below. *Thorax:* Mesonotum and scutellum brownish pollinose, shining in ground color; pleurae and metanotum faintly cinereous; humeri black, halteres yellow; propleurae with a brush composed of ten to twelve long yellow hairs on posterior margins; coxae brown with yellowish tinge, trochanters usually yellow; extreme bases and apices of femora, tibiae, except for median discolorations, and first four tarsal subsegments yellow, femora otherwise dark brown to black, last subsegments of tarsi brown, posterior metatarsi equal in length to next three tarsal subsegments; femoral spines well developed; apical bristles of tibiae weak. *Wings:* Faintly brownish tinged, iridescent; third section of costa slightly longer than fourth, stigma completely filling third section; fifth section of costa about equal to third and fourth together; crossvein r-m situated at about the end of the subcostal vein, and about the basal one-third to one fourth of the discal cell; ultimate section of fourth vein strongly sinuate (fig. 39b). *Abdomen:* Subcylindrical, sides almost straight, first tergum faintly grayed, segments two to five broadly

opaque brown on basal portions, polished black on apices; apical two thirds of fifth segment polished, other segments only polished on apical one third to one fourth. *Hypopygium:* subopaque asymmetrical, compressed to the right, with an apical cleft and a prominent apical keel; about equal to fifth segment in length. Seventh segment visible from above, on the right side (fig. 39d). From ventral view the membranous area extends about half the length of the eighth segment; the cleft on the apical margin is rather 'V' shaped. The harpagones are broad and densely haired (fig. 39c).

Length: body, 4-5.4 mm.; wings, 4.5-6 mm.

The females are inseparable from *ater* (Meigen) and can only be identified by association with the males. These are the only known species in the genus in which the females cannot be distinguished and this lends further proof of their close relationship.

Type locality: Maryland.

The writer has examined the type No. 454, in the Cambridge Museum.

Specimens are at hand from the following states and provinces: Arizona, British Columbia, California, Kansas, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New York, Ohio, Ontario, Pennsylvania, Utah, Vermont, Virginia, and Wyoming.

Dorilas fuscus var. *nitidiventris* (Loew)

(Plate 6, figs. 40a-c)

Pipunculus nitidiventris Loew, 1865, Centuria vi. Berliner Ento. Zeit., IX, 175. New combination.

Pipunculus sororius Cresson, 1911, Trans. Amer. Ento. Soc. Vol. XXXVI, 305. New synonymy.

Pipunculus viduus Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 301-302. New synonymy.

By comparing the types and studying series of homotypic specimens the writer found there were no structural characters by which *fuscus* and *nitidiventris* might be separated, the only difference being that *nitidiventris* has the yellow humeri while those of *fuscus* are black; variations from one to the other have been studied. The type possesses the typical *fuscus* hypopygium with the exception that the cleft is more plainly visible from above (fig. 40b); in this respect it appears to be somewhat intermediate between *fuscus* (Loew) and *ater* (Meigen); the harpagones are broader and not so slender and the membranous area extends almost to the base of the eighth segment on the venter (fig. 40c). On a basis of apparent close relationship *nitidiventris* might best be considered a variety, the name *fuscus* being retained at specific rank as it was the first of the two to be designated by Loew (*fuscus* type No. 454, *nitidiventris* type No. 455).

The females of the typical *fuscus* have not been associated; it is possible that they may fit *nitidiventris* by having yellow humeri or they may be inseparable from *ater*. (Refer to note on *ater*.)

Comparison of the types of *sororius* with *nitidiventris* proved them to be conspecific. Cresson[23] states that he did not know this species but suspected that it was closely related to *horvathi* Kertesz by having the abdomen polished and the humeri black. The type male of *nitidiventris* (Cambridge Museum of Comparative Zoölogy) has the humeri yellow.

Banks[24] suggested that *sororius* was the same as *nitidiventris* Loew.

Type locality of *nitidiventris:* District of Columbia.

Type in Cambridge Museum of Comparative Zoölogy.

The writer has examined specimens of this variety from the following states and provinces: Alberta, Arizona, British Columbia, Iowa, Kansas, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Ontario, Pennsylvania, Quebec, Rhode Island, Saskatchewan, Utah, Vermont and Virginia.

Dorilas (*Eudorylas*) *grandis* n. sp.

(Plate 7, figs. 41a-f)

This species is superficially related to *huachucanus* n. sp. in that the eyes of the male are very narrowly separated on the front, the humeri and knobs of halteres are black and the femora largely black; the front of the female is narrow and the base of ovipositor tuberculate. It does not, however, belong in the typical *atlanticus* group as the ninth segment and harpagones of the male are more normal and the eighth not so symmetrical, with a large apical depression. Aside from the above characters it is distinguished from other species in this complex by having the third antennal segment acuminate; by the great development of the sixth and seventh sclerites and the large apical depressed area at apex of eighth. The inner clasper is not so strongly developed and the outer is more elongated and slender. The female may be distinguished from *huachucanus* by its longer third antennal segment and more elongate ovipositor base.

Male. Rather large, opaque, chiefly bare species. *Head:* Large and rather spherical, about two thirds the length of the thorax; eyes very narrowly separated on the upper two thirds of the front; frontal triangle and face silvery pubescent, upper portion of front

23. 1911, Trans. Amer. Ent. Soc. vol. XXXVI; 304.
24. 1915, Psyche, 22, 167.

shining black; antennae black, bristles of second segment strong; one long ventral bristle extends almost to the tip of the third segment; third segment acuminate, densely white pubescent on lower portion (fig. 41a). Mouthparts yellow, palpi clavate. *Thorax:* Subshining black in ground color, densely pollinose, brownish on the dorsum, gray on the margins; pleurae and metanotum not evenly convex, with a distinct transverse furrow at about dorsal one third; humeri and knobs of halteres black, broad bases and narrow apices yellow; tibiae chiefly yellow with faint discolorations medianly; flexor spines distinct on ventral halves of front and middle femora; apical bristles of tibiae weak. *Wings:* Third costal section scarcely over half the length of the fourth section (fig. 41b); fifth section about equal in length to the fourth; crossvein r-m situated at about the end of subcostal vein and at basal one third of discal cell. Ultimate section of fourth vein strongly sinuate; last section of fifth vein about equal to the posterior crossvein in length. *Abdomen:* Sides nearly straight, scarcely rounding; basal one half to two thirds of each tergum opaque brown, the apical portions and sides being cinereous, the vittae interrupted medianly with brown. *Hypopygium:* About equal in length to the fifth, rather symmetrical in dorsal outline but with a large apical depression slightly to the right side. The sixth and seventh sclerites are very well developed, plainly visible from dorsal view, the seventh occupying most of the left side of the hypopygium; the suture separating the eighth from the seventh runs longitudinally on the dorsum (fig. 41e). From lateral view the seventh sclerite is longer than the eighth (fig. 41c), the sixth extends around the venter and gives support to the floor of the genital chamber. Ninth segment yellowish; from ventral view the ninth is about as wide as long, somewhat asymmetrical, with the left side more strongly developed at the apex; apical cleft 'V' shaped and rather deep. Harpagones rather long and slender, inner one more elongated and strongly curved downward on apical portion; the outer is simple, rounded at apex and gently tapering from base (fig. 41d).

Length: body, 4.8-5 mm.; wing, 5.8-6 mm.

Female. Eyes narrowly separated on the front; front on upper one third being but little wider than the median ocellus. Lower two thirds of front silvery, upper one third opaque to subshining black. Base of ovipositor elongate, somewhat tuberculate toward the apical portion, below; piercer slender, sharply pointed, about equal to base in length (fig. 41f).

Holotype ♂: Chiricahua Mts., Arizona, July 4, 1940 (D. E.

Hardy); allotype ♀, same data. One paratype ♂, same locality and date (R. H. Beamer). All in the Snow Entomological Collection.

These specimens were taken hovering just above the water of a small mountain stream. They were apparently there to lap up moisture from wet rocks.

Dorilas (Eudorylas) harmstoni (Hardy-Knowlton)

(Plate 7, figs. 42a-b)

Pipunculus harmstoni Hardy-Knowlton, 1939, Ann. Ento. Soc. Amer. XXXII, 115-116.

Following is the original description:

"*Male*. Antennae (fig. 42a) shining black; face and front silvery, front slightly raised above antennae and with a narrow black stripe down the middle. Eyes broadly contiguous. Uppermost part of occiput, mesonotum, scutellum and most of abdomen brownish pollinose, very faintly shining. Two indentations on the sides near the posterior edge of mesonotum. Lower portions of occiput, pleurae, coxae, metanotum and sides of abdomen gray pollinose. Humeri whitish, halteres black. Trochanters brownish yellow, apices of trochanters and femora yellow; femora otherwise black, lightly gray dusted. Tibiae and tarsi yellow, tibiae slightly browned medially below. Femoral and tibiae bristles weak, posterior tibiae noticeably curved.

"Abdomen with fifth segment one and one half times as long as fourth. Hypopygium about three fourths as long as fifth, compressed to the left with a basal cleft not extending to the apex (fig. 42b), intermediate lobe slightly visible from above. Abdomen as well as thorax chiefly bare.

"Wings very lightly browned, darkened stigma; third costal section longer than fourth. Last section of fourth vein almost straight; ultimate section of fifth equal in length to the posterior crossvein. Anal cell with a long petiole; r-m crossvein opposite end of auxiliary vein and at basal one fourth of discal cell.

"Length: body, 3.5 mm., wing, 4.2 mm."

Female unknown.

Type locality: Millville, Utah.

Type in United States National Museum.

Dorilas (Dorilas) houghii (Kertesz)

(Plate 7, figs. 43a-d)

Pipunculus houghii Kertesz, 1900, Wiener Ent. Zeit. XIX, 244. Change of name for *lateralis* Walker (nec Macquart), 1852, Insecta Saundersiana. Diptera; 216.
Pipunculus femoratus Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 302.

This species may be distinguished from related species by the thickened femora and yellow legs.

The species recognized in this paper as *pallipes* (Johnson) has previously been erroneously known as *houghii* (Kertesz). Study of Walker's type of *lateralis* by Banks and Calvert completely reversed the conception of these species when they found the femora to be thickened and with well developed femoral spines.

Male. Sparsely pilose species; antennae (except arista), mouthparts, humeri, halteres and legs yellow. Third segments of antennae acute (fig. 43a), first two sections of arista yellow, the long flagellum black; front and face silvery, eyes joined above, for about the distance of the frontal triangle; occiput entirely cinereous, more faintly grayed above. *Thorax:* Subshining in ground color, dusted with brown on mesonotum, grayed on the pleurae and metanotum; scutellum shining; propleurae with a conspicuous brush of long yellow hairs on hind margins; coxae black, femora sometimes slightly discolored with brown medianly, last tarsal subsegments brown; posterior femora especially thickened and the femoral spines are well developed, more so toward apex; the posterior tibiae are strongly arcuate and the hind basitarsi almost equal to the next four tarsal subsegments in length. *Wings:* Lightly brownish tinged; third section of costa equal to slightly longer than fourth, stigma completely filling third section; fifth section of costa shorter than third and fourth combined; crossvein r-m at about the end of the subcostal vein and at basal one fourth to one fifth of discal cell; ultimate section of fifth vein very slightly curved (fig. 43b). *Abdomen:* Shining black, grayed on first tergum and lateral margins of other segments, bases of these segments very narrowly opaque. *Hypopygium:* Faintly cinereous, strongly developed and asymmetrical, compressed to the right with a broad cleft and small apical keel; hypopygium almost as long as fifth segment (fig. 43d). Ninth segment and harpagones black; harpagones symmetrical and rather slender.

Length: body, 4.5-5.0 mm.; wings, 5.5-6.3 mm.

Female. Front entirely silvery; strongly narrowed on upper portion near vertex. Thorax and abdomen faintly gray dusted, the polished black ground color shining through. In the paratype female of *femoratus* the sides of segments two to five are faintly and narrowly yellowish on their apical margins; ovipositor rather short and stout, base somewhat elongated (fig. 43c), equal to piercer in length; otherwise like male.

Type locality given as North America.

Type in British Museum.

The writer has examined the type of *femoratus* at the Boston Society of Natural History and also specimens from the following states and provinces: Florida, Georgia, Kansas, Illinois, Maryland, Massachusetts, New York, North Carolina, Ohio, Ontario, Pennsylvania, Rhode Island, Vermont, Virginia and Washington, D. C.

Dorilas houghii apicarinus (Hardy-Knowlton)

(Plate 7, figs. 44a-b)

Pipunculus femoratus var. *apicarinus* Hardy-Knowlton, 1939, Ann. Ento. Soc. Amer. XXXII, 114-115.

This should probably be considered a western subspecies, it differs from the typical *houghii* in having the third segments of the antennae brown to black, stigma and third costal section longer than the fourth section; thorax with two faint median vittae, posterior femora not so strongly incrassate and the membranous area of the hypopygium is more apical and not so extensive; the difference in the hypopygium would suggest that this might be a distinct species.

The following is the original description:

"*Male.* Front, face and occiput silvery, antennae dark brownish to black, second segment with a faint yellowish tinge; third segment conically acute as in typical variety. Halteres and humeri bright yellow. Mesonotum and scutellum with brownish yellow pollen, grayish on the sides with two faint grayish vittae longitudinally. Pleurae and metanotum cinereous, occiput, dorsum of thorax and abdomen covered with fine, short yellow hairs, less dense on the abdomen. Coxae black, the rest of legs yellow, except for the brownish median portions of the femora. Mesothoracic coxae with several long hairs apically, meso and meta-thoracic trochanters each with a few yellow hairs below. Femoral and tibial spines fairly well developed but not so strong as in typical *houghii*.

"Abdomen chiefly shining, first segment whitish pollinose on the sides, somewhat brownish in the middle, other segments only slightly grayed on their sides and anterior margins. Hypopygium almost as large as fifth segment, strongly compressed to the right with an apical cleft and well developed keel (fig. 44b).

"Wing hyaline, somewhat iridescent, third costal section and colored stigma one and one-half times as long as fourth section (fig. 44a). Ultimate section of fourth vein sinuate. Last section of fourth equal to posterior cross vein. Anal cell with a petiole of medium length; r-m crossvein at or but slightly before end of auxiliary vein and at basal one-fourth to one-third of discal cell."

Type locality: Wolf Creek Pass, Utah.

Type in the United States National Museum.

Dorilas houghii var. *curvitibiae* (Hardy)

Pipunculus femoratus var. *curvitibiae* Hardy, 1939, Jour. Kans. Ent. Soc. Vol. 12, No. I, 19-20. New combination.

This variety is differentiated by having the antennae entirely brown to black; the thorax and abdomen clothed with rather long dense yellow-gray pile; femora brownish black, yellowed only basally and apically. The posterior tibiae are very strongly curved and the femoral spines pronounced. The abodmen is opaque to subshining in ground color, thickly covered with brown pollen above; first segment and lateral margins of two to five cinereous, the cinereous

pollen extending from sides across the apical margins of the segments, interrupted medianly by brown. The hypopygium is typical.

Length: body, 5.3 mm.; wing, 5.8-6 mm.

Female unknown.

Type locality: Cave Cr. Canyon; Chiricahua Mts., Arizona.

Type in the United States National Museum.

Dorilas (Eudorylas) huachucanus n. sp.

(Plate 7, figs. 45a-g)

This species is related to *atlanticus* (Hough) but is easily distinguished by the broad black bands of the femora, black antennae, the very narrow front of the females and the difference in the genital structures of both sexes. The base of the ovipositor is largely black, strongly tuberculate on underside, somewhat squared posteriorly, piercer more slender. From dorsal view the base of ovipositor rounded, not quadrate in outline. The male abdomen is more straight, sides scarcely rounding; the seventh sclerite is visible only at upper left side of hypopygium, not extending toward the apex as in *atlanticus;* the sixth sclerite is very small, never visible from dorsal view. The eighth segment is evenly rounded without an indented area on right side or a visible membranous area at apex as in *atlanticus* and the ninth segment is not visible from dorsal view. From ventral view the seventh sclerite is not so prominent and the ninth segment is much more elongated, not so broad and rounding as in *atlanticus.* The inner harpagone is more strongly curved and flattened apically like a disk, folded up under ninth segment in normal position, not flattened laterally and extended as in related species. The outer harpagone is more acute at apex and also folds in toward the genital chamber in normal position.

Male. Almost entirely bare species. *Head:* Eyes very narrowly separated on upper two thirds of front; the front widens out again just before the ocellar triangle; lower one third of front subshining black in ground color, thinly covered with whitish pubescence, upper two thirds of front shining black; face silvery pubescent, slightly swollen; antennae black, bristles of second segment rather strong; third segment acute (fig. 45a), thickly covered with light pubescence. Occiput moderately developed, lightly dusted with gray on upper portion and densely cinereous below. *Thorax:* Dorsum subshining black in ground color, mesonotum and scutellum thickly covered with brown pollen (microscopic scales); pleurae and metanotum cinereous, metanotum with faint indication of a transverse furrow just above middle; propleurae bare; humeri black; knobs of halteres brownish

black, stems yellowish. *Legs:* All coxae black, anterior and median trochanters black with a yellowish tinge, hind coxae mostly yellow; femora largely black, broad apices and narrow bases yellow; more of the bases yellowed on hind femora; tibiae and basitarsi yellow, other tarsal subsegments blackened, with a yellowish cast; femora slender, femoral spines weak; posterior tibiae slightly arcuate; posterior basitarsi about equal to remaining subsegments; bristles at apex of last subsegment very strong, equaling or longer than the length of the tarsal claws. *Wings:* Much as in *atlanticus;* the third costal section is slightly shorter than the fourth and the fifth section is but little longer than the fourth; the stigma is dark brown in color and occupies all of the third costal section; crossvein r-m is situated at about the end of the subcostal vein and near basal one fourth of the discal cell; the ultimate section of fourth vein is strongly sinuate. *Abdomen:* Sides almost straight, slightly widest at about segment three; first tergum entirely cinereous, lateral brushes each composed of three to four strong black bristles on lateral margins and a few weak pale hairs toward the dorsal portion; other terga brownish pruinose on anterior three fourths, cinereous on posterior margins and on the sides; the cinereous bands are partially interrupted medianly by brownish pollen. *Hypopygium:* Symmetrical, the eighth segment without depressed areas, seventh sclerite scarcely visible from dorsal view (fig. 45b). From lateral view the sixth sclerite is very small but the seventh is quite well developed (fig. 45f). From ventral view the ninth segment is much longer than wide and twice as long as the length of the eighth; the cleft on hind margin is comparatively small and 'U' shaped (fig. 45g). Harpagones very irregular, the inner one is long, slender, greatly curved and flattened at apex (fig. 45c); the outer harpagone is very small, the lateral margins are produced into obtuse lobes.

Length: body, 4.3-4.6 mm.; wing, 4.8-5.3 mm.

Female. Eyes narrowly separated on front, about as wide as width of median ocellus; apical halves of abdominal terga two to five cinereous, narrowly interrupted with brown medianly; sixth terga largely cinereous with a very thin median brown stripe. Ovipositor as described above, piercer shorter than its large irregular base (fig. 45d); otherwise like the male.

Holotype ♂ : Sunnyside Canyon, Huachuca Mts., Arizona, July 9, 1940 (D. E. Hardy). Allotype ♀ , same locality and date (R. H. Beamer). Paratypes: twenty-six ♂ ♂ , fifteen ♀ ♀ from following localities: same as type (R. H. Beamer, D. E. Hardy), also July 18,

1938 (D. W. Craik); Chiricahua Mts., Arizona, July 9, 1940 (R. H. Beamer, D. E. Hardy); Glasco, Kansas, Aug. 24, 1940 (R. H. Beamer). All in the Snow Entomological Collection.

Dorilas (*Eudorylas*) *kansensis* Hardy

(Plate 7, figs. 46a-b)

Dorylas kansensis Hardy, 1940, Journ. Kans. Ento. Soc. 13, 102-103.

Following is the original description:

"The species differs from *affinis* in being more melanistic; having the third antennal segment shorter, subacuminate below; thorax and abdomen subshining, lightly dusted with gray, abdominal segments without distinct cinereous vittae, fifth segment scarcely longer than the fourth; third section of the costa is slightly shorter than the fourth and ultimate section of fourth vein (M_{1+2}) strongly sinuate (fig. 46a). The upper one-half of the front in the female is shining black and the ovipositor is slightly longer than in *affinis*, extending to the base of the third abdominal segment.

"The male genitalia of *affinis* and *kansensis* are nearly identical from dorsal view, being symmetrical without marked depression apically. The hypopygium is more nearly equal the length of the fifth abdominal tergum in *kansensis*, due to the shortness of that sclerite. From a ventral view the genitalia is very distinctive, the ninth segment is about as wide as long with a deep U-shaped cleft in middle on apical margin, the cleft extends about three-fourths the length of the segment on a median line. The harpagones are broad, bluntly pointed, strongly sclerotized and dark in color; the inner clasper is the wider and very slightly longer than the outer (fig. 46b). The membranous portion is on the apex of the eighth on the right. The seventh sclerite is about the same width as the base of the inner clasper; the sixth segment is reduced to a narrow strip and curves under the clasper giving support to the wall of the genital chamber.

"Length male: body, 3.6-3.8 mm.; wings, 4-4.1 mm.

"Length female: body, 3.5 mm.; wings, 4 mm."

Type locality: Douglas County, Kansas.

Type in Snow Entomological Collection.

Added distribution:

Arizona: Grand Canyon, July 11, 1927 (R. H. Beamer).

British Columbia: Trinity Valley, July 23, 1937 (K. Graham).

Colorado: Wray, Aug. 25, 1940 (L. C. Kuitert); Pingree Park, Aug. 13, 1934 (C. W. Sabrosky); Maybell, Aug. 18, 1940 (R. H. Beamer).

Iowa: 5 mi. E. Renwick, Aug. 9, 1938 (G. O. Hendrickson).

Kansas: Manhattan, May 21, 1931 (R. H. Beamer); Leon, June 20, 1940 (L. C. Kuitert); Garnett, Aug. 31, 1940 (R. H. Beamer); Walnut, Aug. 31, 1940 (R. H. Beamer).

New Mexico: Ruidoso, June 26, 1940 (D. E. Hardy).

Dorilas (*Eudorylas*) *lasiofemoratus* (Hardy-Knowlton)

(Plate 7, figs. 47a-c)

Pipunculus lasiofemoratus Hardy-Knowlton, 1939, Ann. Ento. Soc. Amer. XXXII, 116-117.

Species related to *nigripes* but distinguished by wing venation and genital characters.

Following is the original description with additional notes on the wing venation:

"*Male.* Eyes joined; face and front silvery, vertex and upper occiput shining black, lower portion of occiput gray. Second segment of antennae black with bristles above and below, third segment acute (fig. 47a) tinged with brown but lightly whitish pubescent. Mesonotum and scutellum opaque brownish black, the margins slightly grayed. Pleurae, coxae, humeri and metanotum cinereous; humeri black in ground color. Scutellum sparsely bristled on posterior margin. Knobs of halteres black, stems brownish. Trochanters, femora and tibiae chiefly black with cinereous pollen, their apices, bases of tibiae and of hind femora yellow; the inner edge of the posterior femora brownish and shining. Tarsal segments one to four yellow, fifth brownish; tarsal claws and pulvilli yellow, the claws with black tips. Apical three fifths of anterior femora with two rows of spines extending almost to bases. All femora with a row of long bristles toward the dorsal edge on each side. Posterior femora with dense long curved hairs below and a row of long hairs dorsally on the inner side. All tibiae with numerous rows of short spines having short black hairs intermixed and a dense brush of short yellow hairs beneath anteriorly. Pile of tarsi chiefly black above, yellow beneath, posterior tibiae and femora arcuate.

"First segment of abdomen silvery gray, pollinose on sides and along anterior margin, narrowly interrupted with brown in the center. Segments two to five finely gray pollinose on the sides and anterior margins with broad interruptions in the middle; abdomen otherwise shining black with a slight brownish tinge. Lateral comb of first abdominal segment composed of long black hairs. Abdomen with hypopygium small, slightly exceeding one half length of the fifth segment of the abdomen; apically cleft and with a slight keel (fig. 47c), also a smaller cleft basally just to the right of center."

Wings faintly iridescent, third section of costa shorter than the fourth, stigma little over one half the length of the fourth section; fifth costal section shorter than the third and fourth combined (fig. 47b). Crossvein r-m situated beyond the end of subcostal vein and at about middle of discal cell; ultimate section of fifth vein strongly sinuate.

Length: body, 3.8 mm.; wings, 4.3 mm.

Female unknown.

Type locality, Nibley, Utah.

Type in United States National Museum.

Dorilas (*Eudorylas*) *latipennis* (Banks)

(Plate 8, figs. 48a-c)

Pipunculus latipennis Banks, 1915, Psyche, 22, 168.

The very broad wings of this species distinguish it from all other known *Dorilas*.

Female. Antennae yellow, third segment long acuminate (fig. 48a); face and front silvery. Humeri and halteres yellow, knobs of halteres slightly darker than stems; propleurae bare. Legs yellow with only faint discolorations on femora; all femora slender, spines weak. *Wings:* Extremely broad and rounding apically, third section of costa about one half the length of the fourth; apical cell wider at wing apex than length of the r-m crossvein; crossvein r-m situated at basal one fourth of the discal cell; ultimate section of the fourth vein about three times the length of the posterior crossvein and almost straight (fig. 48b). *Abdomen:* Polished, lateral margins and entire first segment gray. Ovipositor short, piercer about equal to its short globose base (fig. 48c).

Length: body, 2.6 mm.; wing, 3 mm.

Male unknown.

Type locality: Falls Church, Virginia.

Type in Cambridge Museum of Comparative Zoölogy.

This species is known only from the type female.

Dorilas (*Eudorylas*) *lautus* n. sp.

(Plate 8, figs. 49a-e)

This species is related to *subopacus industrius* (Knab) but is distinguished by having the hypopygium twice as long as fifth abdominal segment, the large tuberculate ninth segment, the comparatively small eighth and the strongly curved harpagones; specimens are also of larger size.

Male. Moderately sized, opaque, chiefly bare species. *Head:* Eyes joined on upper two thirds of front, frontal triangle and face silvery pubescent; antennae black, bristles of second segment short; third segment acuminate (fig. 49a); mouthparts yellowish, palpi with brown. *Thorax:* Mesonotum and scutellum densely brownish pruinose, grayed on the sides; pleurae and metanotum cinereous, metanotum evenly convex without an indication of a transverse furrow; humeri yellow, knobs of halteres black; dorsocentral and marginal hairs very weak, propleurae bare. *Legs:* Chiefly black except for yellow apices of femora and tibiae, broad bases of tibiae

and first three tarsal subsegments; front and middle with rather strong apical bristles on the venter. *Wings:* Third costal section about equal to fourth, fifth section much shorter than third and fourth combined; stigma dark brown in color, completely filling third costal section; crossvein r-m situated at about end of subcostal vein and at about basal one third of discal cell; ultimate section of fourth vein slightly sinuate. *Abdomen:* Broad and short, chiefly opaque brown, faintly grayed on posterior margins of the segments, distinctly so on the sides; sides of abdomen straight, segments comparatively short. *Hypopygium:* Very large, symmetrical and rounding, twice as long as fifth abdominal segment and longer than the fourth and fifth segments combined (fig. 49e). The sixth segment is scarcely visible from dorsal view; the seventh segment is distinct. From ventral view the ninth segment is strongly developed, equal or larger than the comparatively small eighth segment; ninth segment distinctly tuberculate on outside margin, apical cleft shallow and 'U' shaped. Harpagones strongly curved inward, produced somewhat bootlike at their apices (fig. 49d). Cerci rather small, not obscuring the bases of harpagones.

Length: body 3.5-3.7 mm.; wing, 4 mm.

Female. Runs in the *kansensis-affinis* group but is readily distinguished by the unusual development of the ovipositor base. Front broad, chiefly silvery, with a median ridge of black extending about one third its length from ocellar triangle. Third antennal segment longer acuminate than in the male. The abdomen is slightly clavate from lateral view due to the expansion of the fifth and sixth segments. Ovipositor base about equal to size of sixth segment (fig. 49b) from lateral view and somewhat compressed dorso-ventrally (fig. 49c), a distinct line of articulation is present between piercer and base. Piercer, from line of articulation, about equal to base. The fifth and sixth terga extend to the venter and form a groove into which the ovipositor fits when in resting position.

Holotype ♂: Tajique, New Mexico, VI-25-40 (R. H. Beamer); allotype ♀, same locality and date (D. E. Hardy). Paratypes: two ♂ ♂, one ♀, same locality and date (R. H. Beamer, D. E. Hardy); one ♂, Cloudcroft, New Mexico and one ♂, one ♀, Ruidoso, New Mexico, June 26, 1940 (R. H. Beamer, D. E. Hardy). All in the Snow Entomological Collection.

Dorilas (*Eudorylas*) *loewii* (Kertesz)

(Plate 8, figs. 50a-e)

Pipunculus loewii Kertesz, 1900, Wiener Ent. Zeitung, XIX, 244. Change of name.
Pipunculus fasciatus Loew (nec. v. Ross), 1872, Centuria X. Ber. Ent. Zeit. XVI, 88.
Pipunculus semifasciatus Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 288-289. New synonymy based upon comparison of the types.
Pipunculus nigricornis Adams, 1903, Kans. Univ. Sci. Bull. II, No. 2, 36. New synonymy based upon study of type.

D. fasciatus has been unidentifiable from the description, Cresson keys it in the group with a non-cleft hypopygium. Examination of the type, No. 451, in the Cambridge Museum proved that it belongs in an entirely different group.

Male. Head: Upper occiput and vertex shining black, sides of occiput, front and face cinereous to silvery pubescent; occiput rather narrow; antennae dark brownish to black, third segment acute (fig. 50c). *Thorax:* Mesonotum and scutellum subopaque, finely brown dusted; pleurae and metanotum grayish pollinose; humeri brown, knobs of halteres black, stems yellowish, propleurae bare; coxae and trochanters brown, femora chiefly black with apices and sometimes bases yellow; tibiae discolored with brown in the middles, otherwise yellow; last tarsal subsegments brown; femora moderately thickened, spines well developed; posterior tibiae arcuate. *Wings:* faintly infuscated and iridescent, third costal section about as long as fourth, stigma pale brownish and almost filling the third costal section; fifth section of costa shorter than third and fourth combined; ultimate section of fourth vein (M_{1+2}) strongly sinuate; radio-medial crossvein situated at about the basal one third of the discal cell; last section of fifth vein about equal in length to posterior crossvein; petiole of cubital cell comparatively long (fig. 50d). *Abdomen:* Opaque brownish to black at the base of each segment, distinctly cinereous on their posterior portions, these facia are broadly interrupted with brown on segments two and three, faintly so on segment four and continuous on segments one and five. Abdomen short, rather rounding on the sides, widest at segments two to three. *Hypopygium:* About three fourths as long as fifth segment, with a large apical cleft and a distinct terminal appendage-like keel (fig. 50e); this appendage is not plainly visible from a direct dorsal view, unless extended. From ventral view the membranous portion of the eighth covers most of that segment. The ninth segment is about as broad as long with a shallow, broadly 'V' shaped cleft on hind margin. Harpagones long, rather slender and rounding apically (fig. 50b); cerci small.

Length: body, 4.2 mm.; wing, 5 mm.

Female. Front shining black on upper one half, lower portion silvery pubescent; raised in the center on upper part with a ridge of shining black extending down into the silvery portion; widest at about middle and slightly narrowed toward the antennae and the vertex. The abdominal segments are not so distinctly fasciated and are subopaque to faintly shining. The ovipositor is very long and slender, reaching beyond base of abdomen (fig. 50a).

Type locality: Belfrage, Texas.

The writer has studied the type in Cambridge Museum and has specimens from the following states: Arizona, Kansas, Massachusetts, Minnesota, Missouri, New Hampshire, New Mexico, New York, North Carolina, South Dakota, and Virginia.

Dorilas (*Dorilas*) *luteicornis* (Cresson)

(Plate 8, figs. 51a-c)

Pipunculus luteicornis Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 307.

This is very close to *fuscus* (Loew) and *ater* (Meigen) and may eventually prove to be a subspecies of one of these. It can be separated by the yellow antennae, humeri and bases of femora, but structurally it is not a distinct species.

Female. Head: Third antennal segment acute (fig. 51a), bright yellow to slightly brownish; face and front silvery; front slightly wider at one third to one half the distance from vertex to antennae; mouthparts faintly yellowed. *Thorax:* Subshining in ground color, faintly to rather densely dusted with brown to gray pollen on the dorsum, scutellum mostly shining; pleurae, metanotum, first abdominal segment and lateral margins of segments two to five cinereous; humeri and halteres yellow, propleurae each with a small brush of long yellow hairs; dorsum of thorax and abdomen rather sparsely covered with short pale pile; legs chiefly yellowish, all femora with very broad brown to black rings, coxae black, trochanters discolored; femora moderately thickened, femoral spines distinct on apical one third. *Wings:* Hyaline, faintly iridescent. Stigma completely filling third costal section; third section equal to fourth in length; third and fourth together almost equal to fifth section of costa; crossvein r-m situated at about the end of the subcostal vein and at basal one fourth of discal cell; ultimate section of fourth vein (M_{1+2}) sinuate; last section of fifth vein (Cu_1) about equal in length to the posterior crossvein (fig. 51b). *Abdomen:* Chiefly polished with only first segment and lateral margins of two to five cinereous; sixth segment entirely polished; ovipositor shining, base somewhat globose, brown

to black; piercer yellowish, but slightly longer than the base (fig. 51c).

Length: body, 3.8 mm.; wing, 3.8 mm.

Male unknown.

The association of the male will clear up any doubt as to the position of this species.

Type locality: Machias, Maine.

Type at Boston Society of Natural History.

The writer has examined the holotype, also a homotype from Hampton, New Hampshire, June 24, 1910 (S. A. Shaw). Specimens from Quinault, Washington, 7-26-31 (R. H. Beamer); Mt. Washington, N. H. (Mrs. Slosson) and Cold Springs Harbor, Long Island, July 25, 1932 (Curran) compared in all respects with the type.

Dorilas (*Eudorylas*) *minor* (Cresson)

(Plate 8, figs. 52a-f)

Pipunculus minor Cresson, 1911, Trans. Am. Ent. Soc. XXXVI, 293-294.

This is a rather widely distributed and well distinguished species.

Male. Head: Front and face silvery pubescent, eyes joined on the front for about the length of the frontal triangle; occiput cinereous, mouthparts yellowish; third segment of antennae long acuminate (fig. 52a), bright yellow to faintly brownish in color; base of arista slightly yellowish. *Thorax:* Mesonotum subopaque brown dusted, grayed on the sides; metanotum and pleurae cinereous; scutellum subshining, only faintly dusted; humeri and halteres yellow, propleurae bare. Thorax and abdomen almost devoid of pile; legs almost entirely yellow, coxae blackish, femora usually with narrow discolorations of brown, last tarsal subsegment brown; femora slender, spines weak; hind tibiae slightly bowed. *Wings:* Faintly iridescent, third section of costa longer than fourth, stigma completely filling the third section; fifth costal section about equal to the third and fourth combined; crossvein r-m situated at the basal one third of discal cell, ultimate section of fourth vein straight (fig. 52b). *Abdomen:* Subopaque to faintly shining in ground color, densely brownish pollinose; apical margin of first segment and lateral angles of following segments grayish. Sides of abdomen almost straight, fifth segment twice as long as the fourth. *Hypopygium:* Rather small, little over one half the length of the fifth segment; with a very distinct apical cleft (fig. 52e). Ninth segment and harpagones yellowish; harpagones symmetrical, rather slender and bluntly pointed (fig. 52f). From a lateral view the twisting of the post-abdominal segments is clearly seen. Segments six to nine have

become twisted around to the right; six occupies an almost ventral position, segment seven has been pulled to the right and turned under and is covered above by the fifth tergum.

Length: body, 3-3.5 mm.; wings, 3.8-4 mm.

Female. Front chiefly cinereous with a narrow line of shining black extending about half way down middle from ocellar triangle. Abdomen usually subshining only faintly grayed on the margins, in some specimens the apices of the segments are distinctly gray vittate. Ovipositor yellowish, piercer short, about equal to base in length, base of ovipositor broad and rounding (fig. 52c).

Type locality: North Haven, Connecticut.

Type at Boston Society of Natural History.

The writer has examined the type series, also specimens from the following areas, this covers the known distribution of the species: Arizona, California, Connecticut, Kansas, Maryland, Massachusetts, Maine, Michigan, New Hampshire, New Mexico, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Dakota, Texas, Utah, Vermont, Virginia, Washington, also Quebec, Ontario and México.

Dorilas minor cressoni (Johnson)

Pipunculus cressoni Johnson, 1919, Bull. Amer. Mus. 41, 433. New combination.

By examination of the type male, *cressoni* Johnson, at the Boston Society of Natural History, appears to be a subspecies of *minor* Cresson, differing from the typical form in having the hypopygium, sides and venter of abdomen yellow, no specific differences were observed.

This subspecies is southern in distribution, apparently ranging through southern United States on down into the tropics.

Jamaica is the type locality of *cressoni;* the writer has a homotypic series from Adel, Georgia, 8-11-39 (R. H. Beamer); Griffin, Georgia, 8-12-39 (R. H. Beamer, D. E. Hardy).

These specimens were all taken sweeping in *Arundinaria* (wild cane) and were associated with leafhoppers of the genus *Arundanus* and the Fulgoridae, *Stenocranus arundineus* Metcalf. Whether they parasitize both of these is not known but there is apparently some degree of host specificity.

Dorilas (*Eudorylas*) *montivagus* n. sp.

(Plate 8, figs. 53a-e)

This species is related to *tarsalis* (Banks) but is readily distinguished by the shorter third costal section and minute stigma; the eyes of the male are narrowly separated on the front, the hypopyg-

ium has a distinct depressed area at apex and the eighth segment is not over half the length of the fifth from dorsal view.

Male. Almost entirely bare, chiefly shining black species. *Head:* Eyes narrowly separated on the front, face and lower one third of front silvery pubescent, upper two thirds of front shining black; lower portion slightly convex; bristles of second antennal segment weak; third segment yellow, long acuminate below (fig. 53a); mouthparts bright yellow. *Thorax:* Subshining black, faintly brownish pruinose on the dorsum, grayish on pleurae and metanotum; metanotum evenly convex, with no indication of a transverse furrow; humeri and halteres bright yellow. Dorsocentral and marginal hairs weak, propleurae bare. *Legs:* Coxae, broad apices and narrow bases of femora black, legs otherwise yellow; flexor spines of femora very weak, no prominent apical bristles on tibiae. *Wings:* Third costal section one half to one third the length of the fourth, fifth section more than one and one half times the length of third and fourth combined; stigma occupying just the apex of third section; crossvein r-m situated at about middle of third costal section and at about basal one fourth of discal cell; ultimate section of fourth vein strongly curved, last section of fifth shorter than the length of posterior crossvein (fig. 53b). *Abdomen:* Polished black, lateral margins of segments two and three sometimes faintly yellowish in ground color; sides of abdomen straight. *Hypopygium:* Symmetrical, rather evenly rounding, with a distinct apical membranous area slightly to the right side; seventh sclerite scarcely visible from dorsal view (fig. 53d); from ventral view the ninth segment is about as broad as long, with a rather shallow 'U' shaped cleft on hind margin; harpagones asymmetrical, the outer being twice as broad as the inner; the inner harpagone is slender and somewhat curved inward at apex while the outer is broad, flattened laterally and concave on inner margin (fig. 53c); cerci rather small.

Length: body, 3.8-4 mm.; wings, 4.3-4.6 mm.

Female: Front broad, as wide as the ocellar triangle, shining black on upper one half, silvery below. Sides of segments three and four yellowish on posterior margins, most of the venter yellowish in ground color. Base of ovipositor subglobose with a small tubercle near apex, below. Piercer short and thick, gradually tapering from its base (fig. 53e), about equal to base in length.

Holotype ♂: Cameron Pass, Colorado, Aug. 20, 1940 (G. F. Knowlton). Allotype ♀ same data, one paratype ♂ same locality as type, Aug. 19-22, 1940 (C. W. Sabrosky), one paratype ♂ Pingree Park, Colo., Alt. 9200 ft., VIII-14-1934 (C. W. Sabrosky).

Holotype and allotype returned to G. F. Knowlton, Utah State Agricultural College. One paratype returned to C. W. Sabrosky, Michigan State College, and one retained in the Snow Entomological Collection.

Dorilas (*Eudorylas*) *nevadaensis* n. sp.

(Plate 9, figs. 54a-f)

This species is related to *stigmaticus brachystigmaticus* (Hardy-Knowlton) but is readily separated by the wing and genital characters. The wings are narrow, not broad and rounding as in *stigmaticus;* vein R_{1+2} lies close to the subcostal vein so that the subcostal cell is much more narrow than in *stigmaticus;* apical cell greatly attenuated at wing apex, instead of broad and widely open. The base of the ovipositor is more elongated and the piercer is short and rather thick, but little longer than its base instead of twice as long as in the related species and curved instead of straight, the front of the female is not so shining and is somewhat carinated above antennae. The ninth segment of the male is larger, broad and swollen, being about as large as the eighth segment, extending farther toward the apex on the left side. The cleft of the ninth is narrowly 'U' shaped, not so broad and deep (compared to length of the segment), extending about one third its length instead of about half as in *stigmaticus.* The harpagones are black instead of yellow, bare instead of haired, and are acutely pointed apically. The cerci are smaller more anterior in location, scarcely extending past apices of ninth segment (fig. 54f). It is a more opaque species.

Male. Head: Antennae black, third segment acuminate, with a dense fringe of pale pile above; eyes joined for two thirds the length of the front; front slightly gibbose, subshining black in ground color, densely covered with silvery pubescence; mouthparts brownish to black, tip of labellum slightly yellowish. *Thorax* (and abdomen) subopaque, the shining ground color being obscured by brownish pollen; humeri black, propleurae bare; halters brownish to black; legs almost entirely black, only extreme apices of femora and tibiae, broad bases of tibiae and first tarsal subsegments yellow; rest of tarsi brownish to black; femoral spines very weak. *Wings:* Lightly iridescent, long and narrow; third costal section short, about one-third to one half the length of the fourth, the stigma rather obscure because of the thinness of the subcostal cell and occupying apical portion; crossvein r-m located beyond the end of subcostal vein and before basal one third of the discal cell; ultimate section of fourth vein sinuate. Abdomen with sides slightly rounding, widest at seg-

ments two to three. *Hypopygium:* Symmetrical, broadly rounding, slightly shorter than eighth segment from dorsal view; from this view the seventh sclerite is plainly visible on the right side and the large ninth segment on the left side (fig. 54d). From lateral view the ninth segment is large and somewhat swollen, being almost as large as the eighth segment (fig. 54e). From ventral view the ninth segment extends over half the length of the eighth and its entire length is about equal to the length of that segment. The ninth is very broad, square tipped at its apices and the cleft is narrowly 'U' shaped, extending about one third its length on a middle line. Harpagones broad at bases gradually tapering into acute points at apices. Cerci small, not reaching much beyond bases of harpagones (fig. 54f).

Length: body, 3.3-3.6 mm.; wing, 3.7-4.1 mm.

Female. Front with a slightly elevated shining black area extending from ocelli about two thirds its length into the opaque area; lower one third and narrow extensions along eye margins silvery pubescent. Ovipositor short, base rather elongate, not at all globose; piercer thick and somewhat curved downward (in extended position), scarcely longer than base (fig. 54b). Otherwise like the male.

Holotype ♂: Fallon, Nevada, August 12, 1940 (D. E. Hardy). Allotype ♀ and nineteen paratypes, fourteen ♂♂ and five ♀♀, same locality and date as type (R. H. Beamer, E. E. Kenaga, D. E. Hardy). All in Snow Entomological Collection.

Dorilas (*Eudorylas*) *nigripes* (Loew)

(Plate 9, figs. 55a-d)

Pipunculus nigripes Loew, 1865, Centuria VI. Ber. Ento. Zeitsc., IX, 176.
Pipunculus dubius Cresson, 1911, Trans. Amer. Ento. Soc. V. XXXVI, 284. New synonymy.
Pipunculus winnemannae Malloch, 1913, Proc. U. S. Nat. Mus. 43, 655-656. New synonymy. based upon study of types.

The type male of *dubius* Cresson was compared with that of *nigripes* Loew in the Cambridge Museum of Comparative Zoölogy and found to be synonymous. The species which has been recognized as *nigripes* Loew is certainly not this. At present it does not appear to fit any described species and may be new. In this particular group of DORILAIDAE life history studies would be especially valuable.

This species is near *stigmaticus* (Malloch) but is easily separated by its more elongate stigma and third costal section of the wing.

Male. Small, bare and almost entirely black species. *Head:* Front and face silvery, median portion of front with a narrow vertical line of opaque black; eyes joined for about the length of the frontal triangle; vertex and ocellar triangle shining black, occiput

brownish pollinose above, gray on the sides and lower portion; antennae black, third segment short acuminate, bristles of second segment weak (fig. 55a). *Thorax:* Mesonotum brownish pollinose, subshining in ground color; pleurae and metanotum lightly grayed; propleurae bare; humeri brown to black; knobs of halteres brown, stems pale; legs almost entirely black, extreme apices of femora and bases and apices of tibiae usually yellowish; tarsi brownish, tinged with yellow; femora slender, spines very weak, scarcely discernible; tibiae almost straight; posterior basitarsi longer than the next three sections of tarsi. *Wings:* Faintly iridescent; third section of costa longer than the fourth, stigma not quite filling third section; fifth costal section equal to the third and fourth in length; crossvein r-m situated just beyond the end of the subcostal vein and at the basal one third to one fourth of the discal cell; ultimate section of fourth vein almost straight, very slightly curved (fig. 55d). *Abdomen:* Opaque brownish pollinose; short, scarcely longer than the thorax and somewhat rounding on the sides. First tergum and lateral margins of other segments grayish, apices of segments more subshining, bases entirely opaque; fifth segment subshining, lightly dusted on apical half, hypopygium entirely so. *Hypopygium:* Small, symmetrical with no distinct cleft but with a faint depressed area at apex on right side (fig. 55b). Ninth segment and harpagones blackish.

Length: body, 2.3-2.5 mm.; wings, 3.3-3.8 mm.

Female. Eyes widely separated, front wider in middle than just above antennae; upper two thirds to three fourths of front polished black, lower portion, just above antennae silvery. Abdomen more grayish, segments more entirely opaque; sixth segment entirely cinereous. Ovipositor brownish, tinged with rufescent toward piercer; base subglobose with a slight development anteriorly, on under side; piercer plainly articulated and slightly longer than its base, rather slender, reaching to about the apex of the first segment (fig. 55c).

Type locality: Pennsylvania.

The writer has examined Loew's type in Cambridge Museum of Comparative Zoölogy; also the type series of *dubius* Cresson at the Boston Society of Natural History and has homotypic specimens from: Cappens, Maine, July 20; Huntsville, Utah, Aug. 25, 1938 (G. F. Knowlton, D. E. Hardy); and Logan Canyon, Utah, Aug. 7, 1938 (D. E. Hardy, A. T. Hardy). Specimens have also been examined from numerous localities in the following states: California, Connecticut, Georgia, Idaho, Kansas, Maine, Maryland,

Massachusetts, Minnesota, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Tennessee, Texas, Utah, Vermont, and Virginia.

Dorilas (*Dorilas*) *pallipes* (Johnson)

(Plate 9, figs. 56a-f)

Pipunculus pallipes Johnson, 1903, Ent. News, XIV, 107.
Pipunculus houghii Cresson (nec Kertesz), 1911, Trans. Amer. Ent. Soc. XXXVI, 308.

This species is easily recognized by its slender yellow legs, yellow humeri and polished black abdomen.

Male. Almost entirely bare species. *Head:* Front and face silvery, mouthparts and third antennal segment bright yellow; basal two sections of artista yellow, first two sections of antennae yellow-brown to yellow; occiput chiefly cinereous more lightly grayed above, compound eyes joined on upper portion of the front for about the same distance as the length of the frontal triangle; third antennal segment acute, rather small, scarcely twice as large as second segment and densely white pubescent (fig. 56a). *Thorax:* Mesonotum and scutellum polished in ground color, very faintly dusted with brownish pollen; metanotum and pleurae lightly cinereous, the latter sometimes with a tinge of yellow in the ground color. Humeri and halteres bright yellow, propleurae with a brush of long yellow hairs on the hind margins; legs entirely yellow the coxae and apices of tarsi somewhat brownish; femora slender, femoral bristles distinct on apical portions below; hind tibiae slightly arcuate. *Wings:* Lightly iridescent; third section of costa twice as long as the fourth, stigma completely filling the third section; fifth costal section about equal in length to the third and fourth combined; crossvein r-m situated before the end of the subcostal vein and at about basal one fourth of the discal cell; ultimate section of fourth vein almost straight, with but a slight curvature; this section is about equal in length to the third section (that part of media from r-m crossvein to the m); last section of fifth vein much shorter than the length of the posterior crossvein (m) (fig. 56b). *Abdomen:* Subcylindrical, sides almost straight; usually shining black in ground color, venter and sometimes lateral margins yellowish; the first tergum is grayish dusted, the other terga are faintly dusted with gray on the sides and sometimes very lightly pollinose above. *Hypopygium:* Rather small, scarcely over half the length of the fifth segment; asymmetrical, slightly compressed to the right with a large apical cleft toward the right side (fig. 56e); this cleft possesses a small inconspicuous development in the mid-

dle, formed by a folding in the membrane; ninth segment and harpagones yellowish, harpagones slightly asymmetrical, from ventral view the clasper on the left is longer and more curved. The sixth and seventh abdominal sclerites are ventral in position and on the right side; from ventral view the anterior lateral margin of the sixth extends as a long slender projection beneath the harpagones giving support to the membranous genital cavity (fig. 56f). Upon relaxation of the posterior part of the abdomen the depressed area of the hypopygium is expanded and seen to consist of a membranous apical portion.

Length: body, 4.4-5.9 mm.; wings, 5.6-6.3 mm.

Female. Front chiefly silvery, shining at vertex, strongly narrowed just before ocellar triangle. Ovipositor short, base globose, slightly longer than fifth segment; piercer very stout and tapering, about three fourths as long as its base (fig. 56c), apical portion of base with a slight tubercle below. Thorax and abdomen with a yellow-brown tinge. Otherwise like male.

Type locality: Wildwood, New Jersey.

The writer has examined the type at the Boston Society of Natural History and a large series of homotypes. The species has been identified from numerous localities in the following states and Canadian provinces: Alberta, British Columbia, Connecticut, Georgia, Kansas, Maine, Massachusetts, Michigan, Nebraska, New Hampshire, New Mexico, New York, Ohio, Ontario, Quebec, Pennsylvania, Rhode Island, South Dakota, Utah, Virginia and Wyoming.

Dorilas (*Eudorylas*) *reipublicae* (Walker)

(Plate 9, figs. 57a-e)

Pipunculus reipublicae Walker, 1849, List of Dipt. Ins. in British Mus., III, 639.
Pipunculus albofasciatus Hough, 1899, Proc. Bost. Soc. Nat. Hist. XXIX, 85 (*albofasciata*).

This synonymy was established by Cresson[25] and based upon notes and figure of the type of *reipublicae* which were made by Banks. He discounts Malloch's suggestion that this may be the same as *atramontensis* Banks[26] on the basis that the abdomen of the Walker type is broad and the hypopygium large, indicating *albofasciatus* Hough, rather than Bank's species. This writer has not seen the type of *reipublicae* so is unable to confirm or deny this synonymy.

This is a very well defined species, easily recognized by its small stigma, the broad cinereous band on fifth abdominal tergum and

25. 1912, Ent. News, XXIII, 455-456.
26. 1912, Proc. U. S. Nat. Mus. XLIII, 291.

large rather symmetrical hypopygium, with a distinct depression on the left side near apex. The species recognized as *loewii* Kertesz by Banks[27] is apparently *reipublicae* (Walker).

Dorilas reipublicae is an intermediate species between *Dorilas* and *Tömösváryella* although no specimens have been seen which are without a stigma in the wing.

Male. Head: Front silvery to golden pubescent, face silvery; vertex shining, occiput dull black on upper portion, gray pollinose below; compound eyes joined for about one third the distance of the front, narrowly separated above; antennae black, third segment long acuminate (fig. 57a). Mesonotum brownish pollinose, margins gray; pleurae and metanotum cinereous; propleurae bare; humeri and stems of halteres yellow, knobs of halteres yellow-brown to black; legs chiefly black, apices of femora yellow, tibiae discolored with brown to black medianly; first four tarsal subsegments yellow, last subsegment brown; femora slender, spines weak; posterior tibiae only slightly bowed. *Wings:* Iridescent tinged; third section of costa little over one half the length of the fourth, stigma only occupying apical portion of third section; fifth costal section shorter than third and fourth together; crossvein r-m situated beyond the end of the subcostal vein and just before the middle of the discal cell; last section of fourth vein (M_{1+2}) sinuate (fig. 57b). *Abdomen:* Broad, subshining to opaque, sides nearly straight; first segment entirely cinereous, segments two to four brownish pollinose, gray on the sides; fifth with a broad cinereous band across the segment, only a narrow basal portion brownish; fifth segment one and one fourth times as long as fourth and with a small indentation on each side dorsomedianly. *Hypopygium:* Large and rather symmetrical, more shining than abdomen, only lightly dusted; equal to or longer than the fifth segment and with a distinct depression or cleft on the left side (fig. 57e); sometimes a small carina visible, arising from the cleft; ninth segment and harpagones yellowish, the latter symmetrical and broadly rounding apically; aedeagus bifid at its apex (fig. 57d).

Length: body, 3.8-4.2 mm.; wings, 4.3-5 mm.

Female. Front chiefly shining black, only silvery just above antennae. Fifth abdominal segment with two cinereous spots laterally, these are narrowly interrupted medianly; segment not so completely cinereous as in male. Sixth segment almost entirely cinereous, with extreme base and an indistinct longitudinal median line brownish.

27. 1915, Psyche, 22, 166.

Piercer of ovipositor about equal to and rather abruptly terminating its large base; base slightly tuberculate below (fig. 57c). Cresson describes and figures the female wing as being without a stigma. The specimens the writer has examined have the small stigma as in the male.

The females are rare in proportion to the males.

Type locality: New York.

Type in British Museum.

The writer has studied Hough's type of *albofasciatus* from Opelousas, Louisiana in the Field Museum at Chicago.

The species is widely distributed, the writer has examined specimens from the following states and Canadian provinces: Alberta, Connecticut, Florida, Georgia, Iowa, Kansas, Kentucky, Maine, Massachusetts, Michigan, Minnesota, New Jersey, New York, North Carolina, Ohio, Ontario, Oklahoma, Pennsylvania, Rhode Island, Saskatchewan, Tennessee, Virginia, and Vermont.

Dorilas (*Eudorylas*) *sabroskyi* n. sp.

(Plate 9, figs. 58a-f)

This species is related to *affinis* (Cresson) but is characterized by the broad rounding harpagones of the males and by the flattened, distinctly articulated piercer and shorter more oval, opaque yellowish ovipositor base of females; specimens are of smaller size, the third costal section of the wing is much longer than fourth, the legs chiefly black and the front of the female is almost entirely shining.

Male. Small chiefly bare species. *Head:* Eyes contiguous for about length of frontal triangle, frontal triangle chiefly silvery pubescent, verging into opaque black on upper portion; antennae black, third segment acuminate and scarcely wider than the second (fig. 58a); bristles of second antennal segment weak. *Thorax:* Subshining in ground color, brownish pruinose on the dorsum, gray on the pleurae and metanotum; metanotum evenly convex, without indication of a transverse furrow; dorsocentral and marginal hairs weak, propleurae bare; humeri brown to black on lower portions, yellow above. Stems of halteres yellow, knobs yellow-brown; legs chiefly black, narrow bases of tibiae and extreme apices of femora yellow; flexor spines of femora very weak, apical bristles of front and middle tibiae moderately developed. *Wings:* Faintly brownish tinged, third section of costa about twice the length of fourth; fifth section almost equal to third and fourth combined (fig. 58b); crossvein r-m situated just beyond end of subcostal vein and just before basal one third of discal cell; ultimate section of fourth vein straight,

last section of fifth about equal to the length of posterior crossvein. *Abdomen:* Entirely opaque, chiefly brownish pruinose on the dorsum, lightly grayed on apical margins of segments and more cinereous on the sides; sides of abdomen almost straight, fifth segment about one and one half times as long as fourth. *Hypopygium:* Shorter in length than fifth abdominal segment, symmetrical, evenly rounding with no indication of a depressed or membranous area; seventh selerite well developed, occupying most of the left side of hypopygium (fig. 58e). From ventral view the ninth segment is well developed, somewhat swollen and yellowish in color, longer than wide and about equal to the length of the eighth segment; apical cleft of ninth segment broadly 'V' shaped and moderately shallow. Harpagones enlarged and rounding at their apices (fig. 58f) the outer is slightly longer and bends downward at tip.

Length: body, 2.4-2.6 mm.; wing, 3.3 mm.

Female. Front silvery just above antennae, otherwise polished black; the third costal section appears to be consistently shorter, being about one and one half times as long as fourth and the fifth section is shorter than the third and fourth combined. Base of ovipositor dull yellowish, rather strongly developed, globose above, slightly tuberculate below with a distinct line of articulation separating it from the piercer. Piercer short, about equal in length to base, thickened basally and rather gently tapering (fig. 58c); from dorsal view the piercer is rather strongly flattened (fig. 58d).

Holotype ♂: Isle Royale, Michigan, Aug. 3-7, 1936 (C. Sabrosky). Allotype ♀ and four paratype ♀ ♀ same data as type.

Holotype, allotype and two paratypes returned to Michigan State College, others retained in Snow Entomological Collection.

Dorilas (*Eudorylas*) *stainsi* n. sp.

(Plate 10, figs. 59a-c)

This species is related to *caudatus* var. *discolor* but the third antennal segment is very long acuminate, the hypopygium is rounding on the right side, with a depressed area to the left; no membranous area is visible; ninth segment without the marginal indentations and the apical cleft is very shallow; harpagones are short, broad and densely haired, not produced at their apices; wings are also more brownish fumose.

Male. Small, chiefly bare species. *Head:* Eyes joined on the upper two thirds of the front; frontal triangle and face densely silver pubescent, face slightly convex; labellum bright yellow; antennae black, third segment extended into a long slender point (fig. 59a).

Thorax: Faintly brownish pruinose on the dorsum, subshining on the scutellum; pleurae and metanotum gray; metanotum rather evenly convex with but a faint transverse furrow on the upper margin; dorsocentral hairs weak, propleurae bare; humeri black below, yellow on upper portions; halteres yellowish, knobs faintly brown; apices of femora, tibiae, bases of tibiae and first three tarsal subsegments yellow; legs otherwise black, shining below. Femora slender, flexor spines very weak; hind tibiae slightly arcuate, apical bristles of tibiae moderately developed on front and middle legs; posterior basitarsi almost equal in length to the next four tarsal subsegments. *Wings:* Brownish iridescent, third costal section slightly shorter in length than the fourth; fifth section about one and one half times as long as fourth; stigma dark brown, occupying about four fifths of the third costal section; crossvein r-m situated just beyond end of subcostal vein and at about basal one fourth of discal cell; ultimate section of fourth vein very slightly curved; last section of fifth slightly longer than posterior crossvein. Wings rather broad. *Abdomen:* Subshining black in ground color, but rather densely covered with grayish to brown pruinosity; sides almost straight, slightly wider at segments three to four. *Hypopygium:* About equal to slightly longer than the fifth abdominal segment, the left side is almost straight while the right is rounding. Seventh segment scarcely visible from dorsal view (fig. 59c). From ventral view no membranous area is visible on the eighth segment; the ninth segment is longer than wide and longer than the eighth, the apical cleft is very broad and shallow. Harpagones are short and broad, rounding at apices and somewhat concave on inner margins. The cerci are large and well developed, extending almost to the apices of the harpagones (fig. 59b).

Length: body, 3-3.4 mm.; wings, 3.7-4 mm.

Female unknown.

Holotype ♂, Brigham Canyon, Utah, July 15, 1940 (G. F. Knowlton, G. S. Stains). One paratype ♂, same data.

Holotype returned to Utah State Agricultural College, the paratype retained in the Snow Entomological Collection.

Dorilas (Eudorylas) stigmaticus (Malloch)

(Plate 10, figs. 60a-d)

Pipunculus stigmatica Malloch, 1913, Proc. U. S. N. M. 43, 294.

Male. Head: Antennae black, third segment acuminate (fig. 60a) but not so elongate below as in *brachystigmaticus* (Hardy-Knowlton); face and front silvery; eyes joined for as long as the length of

the front; occiput cinereous on the sides and below, dull grayish above. *Thorax* (and abdomen) subshining to subopaque with light gray-brown pollen. First abdominal segment grayish. Humeri black, stems of halteres yellow, knobs brown. Legs chiefly black, only apices of femora and bases and apices of tibiae yellow; tarsi yellow-brown, no distinct femoral spines, hind tibiae arcuate. *Wings:* Hyaline, third section of costa but little more than one half the length of the fourth; stigma very dark, filling three fourths of third section (fig. 60b); costa slightly swollen from end of subcostal vein to end of R_{1+2}, crossvein r-m situated at basal one third of discal cell, beyond end of subcostal vein; ultimate section of fourth vein but slightly sinuate, last section of fifth about equal to the posterior crossvein. *Hypopygium:* Symmetrical, about three fourths the length of fifth segment, with a very slight depression on the left side (fig. 60d). Sides of abdomen nearly straight, slightly wider at segments two to four.

Length: body 3.5 mm.; wings, 4.5 mm.

Female. This sex has not been definitely associated as yet but one specimen (from Virginia) is at hand which apparently belongs here. It fits the description of the female of *stigmaticus brachystigmaticus* (Hardy-Knowlton) with the exception that the third section of the costa is less than one half the length of the fourth, the stigma is darker and fills three fourths of third section; the fifth costal section is about equal to the third and fourth combined and the ultimate section of the fifth vein is much longer than the posterior crossvein (fig. 60c).

Type locality: Kaslo, British Columbia.

The writer has studied the type at the United States National Museum, also specimens from Merritt, B. C., Canada, 8-3-1931 (R. H. Beamer); Abbotsford, Quebec, Aug. 30, 1936 (G. Shewell); Cheboygan Co., Michigan, July 20, 1933 (H. Peters). The female specimen described above is from Falls Church, Virginia, Sept. 5 (N. Banks).

Dorilas stigmaticus brachystigmaticus (Hardy-Knowlton)

(Plate 10, figs. 61a-g)

Pipunculus brachystigmaticus Hardy-Knowlton, 1939, Can. Ent. LXXI, 90.

Comparison of specimens of *brachystigmaticus* with the type male of *stigmaticus* proved that the former should probably be considered a subspecies of Malloch's species. It may be distinguished from the typical form by having the wings brownish tinged, costa normal; third section of costa about one third the length of the fourth;

shorter stigma; radio-medial crossvein situated at basal one fifth of discal cell; third segment of antennae longer acuminate and abdomen more shining without gray pollen.

Male. Species almost bare, only pale microscopic pile present on thorax and abdomen. *Head:* Face silvery, front slightly brownish pubescent; vertex shining, occiput opaque black above, cinereous on the sides; eyes contiguous for the greater part of the front; mouthparts yellowish; antennae brown to black, third segment very long acuminate below (fig. 61a); the bristles of the second antennal segment are very short compared with other species. *Thorax:* Mesonotum and scutellum subshining black, faintly gray dusted on the margins; metanotum and pleurae sparsely dusted with gray, subshining in ground color, sternopleurae shining on lower portions; humeri and halteres black, stems of halteres pale; propleurae bare; legs chiefly black, trochanters faintly yellow tinged, femora yellow on their apices, otherwise black; tibiae banded with brown to black medianly, otherwise yellow; first four tarsal subsegments yellow, fifth brown; posterior femora scarcely thickened, spines very weak; posterior tibiae slightly arcuate; basitarsi elongate, equaling the remaining tarsal subsegments in length. *Wings:* Faintly brownish tinged, iridescent; very broad and rounding apically; third section of costa less than one half to one third the length of the fourth section; stigma very short, occupying only the apical corner of the third section; fifth costal section shorter than third and fourth combined; crossvein r-m situated just beyond the end of the subcostal vein and at about basal one fifth of discal cell; last section of fourth vein (M_{1+2}) slightly curved, shorter in length than the portion of that vein from r-m crossvein to posterior crossvein (third section) (fig. 61f). *Abdomen:* Shining metallic black, first segment subshining, slightly grayed to opaque black; sides of abdomen gently rounding, widest at segments three to four; second and third segment about equal in length, fourth slightly longer than third; fifth segment slightly longer than fourth. *Hypopygium* almost as long as fifth abdominal segment, symmetrical, scarcely compressed to the right, with a small depression at base on right side (fig. 61b). Eighth segment without a visible membranous area at tip. Ninth segment black, harpagones yellowish. Ninth segment longer than wide and rather square-tipped apically, with a broad 'U' shaped cleft on posterior margin; segment not greatly developed and scarcely visible from lateral view (fig. 61g). Harpagones broad, blunt and short densely haired at apices. Cerci large and elongate, about equal to the length of the claspers (fig. 61e).

Length: body, 3.7 mm.; wing, 4.2 mm.

Female. Front shining black on upper three fourths, with two narrow stripes of gray extending from just above antennae part way up the eye margins. Shining portion of front slightly indented. Base of ovipositor black, short and globose; piercer yellowish, narrow, slightly longer than and abruptly terminating its base (fig. 61c); ovipositor reaching to the posterior margin of segment three.

Type locality: Logan Canyon, Utah.

Type at Utah State Agricultural College.

The writer has examined additional specimens from the type locality.

Dorilas (Eudorylas) subopacus (Loew)

(Plate 10, figs. 62a-e)

Pipunculus subopacus Loew, 1865, Centuria VI, Berl. Ent. Zeitsch. IX, 176.
Pipunculus confraternus Banks, 1911, Trans. Amer. Ento. Soc. XXXVI, 285. New synonymy established by comparison of types in Cambridge Museum of Comparative Zoölogy.
Pipunculus occidentalis Malloch, 1913, Proc. U. S. Nat. Mus. 43, 291. New synonymy.

This was described from a unique as a male of a new species having the eyes widely separated above the antennae. Upon examination of type the writer found that the sex of the specimen had been incorrectly determined; it is a typical female of *subopacus.* This mistake is very easy to make if one is not acquainted with the group, the female ovipositor is often folded up into a groove beneath the sixth segment so it is not always clearly visible from ordinary positions; in Malloch's specimen it is in plain sight if viewed from beneath.

Dorilas subopacus is related to *affinis* Cresson; the two are easily separated by the genital structures of both sexes; *subopacus* has the ovipositor short, not elongate and reaching to second abdominal segment as is stated in Cresson's key.

Male. Almost entirely bare species. *Head:* Face and front silvery pubescent, eyes joined for less than the length of the frontal triangle, a very narrow portion of the front exposed for short ways below the ocellar triangle; vertex shining black, occiput chiefly cinereous, more lightly grayed above; third segment of antenna brown, with a long white, acuminate tip below (fig. 62a); bristles of second antennal segment weak. *Thorax:* Subshining in ground color, dusted with brown on the dorsum, gray on the pleurae and metanotum. Humeri yellow; halteres chiefly yellow, knobs faintly browned; propleurae bare. In the typical *subopacus* the legs are chiefly pale in color, with dark bands on the femora, leaving yellow bases and apices; the tibiae are faintly discolored medianly and the last tarsal

subsegments are brownish. Femora slender, flexor bristles weak; posterior tibiae gently arcuate, front and middle tibiae with strong apical bristles; posterior basitarsi longer than the next three tarsal sections in length. *Wings:* Lightly iridescent; third section of costa equal to longer than the fourth, stigma completely filling the third section; fifth costal section shorter than the third and fourth combined; crossvein r-m situated just before the end of the subcostal vein and at basal one third of the discal cell; ultimate section of fourth vein slightly sinuate, about equal in length to the third section of that vein; last section of fifth vein shorter than posterior crossvein (fig. 62d). *Abdomen:* Subshining in ground color, densely brown pollinose, grayed on first tergum and on lateral margins of other segments; abdomen rather broad and flat, sides slightly rounded; fifth segment one and one third times as long as fourth. *Hypopygium:* Large, subshining and symmetrical, as wide as and about one and one half times the length of fifth segment with an inconspicuous small depression apically (fig. 62c). Eighth segment broad and rounding with no visible membranous area. Ninth segment slightly longer than wide and asymmetrical, being much more developed on the right side, apical cleft broadly 'U' shaped. Harpagones symmetrical with well developed lateral expansions on their bases (fig. 62e); apices of harpagones somewhat square tipped as seen from side view, long slender, rather acutely pointed from ventral. Aedeagus terminates in a slender three branched tip and the cerci are moderately developed, extending well beyond apex of ninth segment.

Length: body, 3.3-3.5 mm.; wings, 3.7-4 mm.

Female. The eyes are widely separated on the front and the front is polished black on the upper three fourths, silvery just above antennae. Abdomen more nearly shining and not so flattened as in male. Ovipositor very short sometimes hidden in a groove on the venter. This is formed by an overlapping of the sixth tergum beneath (fig. 62b). Base of ovipositor rather rounding and small, piercer a little longer than base in length (fig. 63a). Sixth tergum completely surrounding the apex of the abdomen, the lateral margins produced until they meet on the venter.

Type locality: Washington.

The writer has examined the type in Cambridge Museum of Comparative Zoölogy and specimens from the following localities; Trail Co., N. D., July 19, 1922 (A. A. Nichol); Manhattan, Kansas, June 9, 1934 (C. W. Sabrosky); Osborne, Kansas; 40 mi. N. Lusk, Wyoming, July '95; Magdalena, New Mexico; Great Falls, Va., June

29; Falls Church, Va.; Medicine Hat, Alberta; Black Mountains, North Carolina, July; East Lansing, Mich., Sept. 14, 1936 (C. Sabrosky); Middleton, Ct., June 17, 1909; Bath, Mich., June 6, 1940 (C. W. Sabrosky) and several localities in Massachusetts, New Hampshire and Minnesota.

Dorilas subopacus industrius (Knab)

(Plate 10, fig. 63a)

Pipunculus industrius Knab, 1915, Proc. Biol. Soc. 28, 83.
Pipunculus confraternus var. *melanis* Hardy-Knowlton, 1939, Ann. Ent. Soc. Amer. XXXII, 113-114. New synonymy.

This form described by Knab as *industrius* is unrecognizable from the original description. Upon examining the type the writer found it to be the same as variety *melanis*.

This is probably best considered a melanistic subspecies, for the most part it appears to be confined to Western United States. The subspecies is distinguished by having the legs more blackened. Only the extreme apices of femora yellow and the tibiae blackened medianly. The third costal section and stigma of the wing are shorter than the fourth section, usually longer in the typical *subopacus*.

Length: body, 3.2-3.5 mm.; wing, 3.5-4 mm.

This is one of the most important parasites of *Eutettix tenellus*, the beet leafhopper, in the West and is no doubt of great benefit in the biological control of this pest. This subspecies is one of the most abundant DORILAIDAE found in the beet leafhopper breeding grounds, it is also one of the few forms on which rearing data have been recorded.

Type locality: King City, California.

The writer has examined the type series at the United States National Museum and has, with Doctor G. F. Knowlton, previously recorded a long list of localities for this subspecies,[28] many of those records were reared from beet leafhopper. It is now known from the following states: Arizona, California, Colorado, Illinois, Iowa, Kansas, Idaho, Michigan, Minnesota, Montana, Nevada, New Mexico, Ohio, South Dakota, Texas, Utah, and Wyoming. Canadian provinces: British Columbia, Manitoba, Ontario, Quebec, and Saskatchewan.

The following are added records of rearings from beet leafhopper or collecting on host plants: Oakley, Idaho, 10-6-36 (swept from *S. pestifer*) (C. F. Henderson); Berger, Idaho, Fords Point, 6-4-35, swept from *Sofia*, (C. F. Henderson); Billings, Montana, 7-21-34,

28. Hardy-Knowlton, 1939, Ann. Ent. Soc. Amer. XXXII, 114.

reared from leafhopper on beets, (D. E. Fox); Davis, California, 8-31-34, Coll. on beets, (C. F. Henderson); East Hammett, Idaho, 6-29-34, reared from beet leafhopper (C. F. Henderson).

This species is commonly taken on the beet leafhopper host plants, sugar beets, *Salsola pestifer*, *Atriplex* spp., *Filaree*, *Bassia hyssopifolia*, *Cheirinia repanda*, et al. They are also taken in other plant associations, and may parasitize other species of leafhoppers; they were taken in abundance in an alfalfa field at Austin, Nevada.

Dorilas (*Eudorylas*) *tarsalis* (Banks)

(Plate 10, figs. 64a-d)

Pipunculus tarsalis Banks, 1911, Trans. Amer. Ento. Soc. XXXVI, 309-310.

Rather small, chiefly bare species, easily recognized by the small symmetrical hypopygium and the short broad claspers of the male.

Male. Head: Face and front silvery, vertex shining; occiput dull gray above, cinereous on the sides and below; occiput rather narrow, not greatly swollen; eyes joined on the front for about the length of the frontal triangle, very narrowly separated for a short distance below the ocelli; first two antennal segments brownish with a yellow tinge, bristles of second segment short; third segment yellowish, densely white pubescent with a very slender acuminate point below (fig. 64a); first two sections of aristae yellowish. *Thorax:* Mesonotum and scutellum subshining in ground color, covered with brownish pollen above, grayed on the sides; pleurae and metanotum gray; sometimes a faint yellowish tinge in the ground color of the pleurae; humeri and stems of halteres yellow, knobs of halteres brown to black; propleurae bare; coxae, trochanters and femora chiefly black, the apices and sometimes the extreme bases of femora are yellow; tibiae yellowish with brown discolorations medianly; apical subsegments of tarsi brownish, otherwise yellow; the basitarsi are longer than the next three tarsal subsegments and the claws are comparatively short. *Wings:* Faintly iridescent, third section of the costa much shorter than the fourth, stigma filling apical half of third section; fifth costal section shorter than the third and fourth combined; crossvein r-m situated at about the end of the subcostal vein and at basal one fourth of the discal cell; ultimate section of fourth vein almost straight, with but a faint curvature; petiole of cubital cell very short (fig. 64b). *Abdomen:* Short, rather broad with the margins gently rounding, widest at segments three and four; first tergum and base of second grayish dusted, dorsum of abdomen otherwise shining black; sides sometimes faintly dusted. *Hypopygium:* Faintly yellowish tinged, rather symmetrical with a de-

pressed area near base on the right side (fig. 64d). Ninth segment and harpagones yellowish; harpagones broad, short and rounding apically, covered with thick hairs (fig. 64c).

Length: body, 3-3.2 mm.; wings, 3.5-3.7 mm.

Female unknown.

Type locality: Ithaca, New York.

The writer has examined the type at Cambridge Museum of Comparative Zoölogy and has studied homotypes from the following localities: Swarthmore, Pa., Aug. 24, 1913 (E. T. Cresson); Falls Church, Va., Sept. 6 (N. Banks); Trout Lake Michigan, Aug. 25, 1925 (H. B. Hungerford). Also specimens from Sunnyside Canyon, Huachuca Mts., Arizona, July 9, 1940 (D. E. Hardy); Two Harbors, Minn., Aug. 14, 1937 (H. T. Peters) and Marshall Co., Kansas, July 10, 1927.

Dorilas (Dorilas) trichaetus (Malloch)

(Plate 11, figs. 65a-d)

Pipunculus trichaetus Malloch, 1913, Proc. U. S. Nat. Mus. 43, 296.

This species is known only from the female and although this sex is well distinguished it is questionable as to just where the males will belong.

Female. Description based upon type. *Head:* Third segment of antenna black, long acuminate below (fig. 65a) and densely covered with silvery pubescence; second antennal segment with two to three long yellow bristles below, reaching about half the length of the segment and several short black bristles above; face and front silvery; upper one third of front and vertex shining black; frontal stripe broadest at middle, with a distinct median elevation or tubercle just above the antennae; occiput silvery to cinereous, more faintly dusted above. *Thorax:* Pleurae and metanotum thickly gray dusted; humeri brown, sometimes faintly tinged with yellowish; halteres yellow, mesonotum and scutellum subshining in ground color with brown pruinosity, grayed on the sides; lateral margins of mesonotum with a few scattered long pale hairs; hind margin of scutellum with a row of eight or more rather weak black hairs; hind margins of propleurae each with a brush of long pale hairs; legs chiefly brown to black, extreme apices and bases of femora and tibiae and first four tarsal subsegments yellow, otherwise brownish to black; the posterior tibiae each with three to four long, pale serial hairs on the anterodorsal surface, at middle; hind tibiae slightly arcuate, bristles and hairs of all femora and tibiae rather strong; posterior basitarsi almost equal to the next four tarsal subsegments in length. *Wings:*

Third costal section slightly shorter than the fourth, stigma pale brown, almost filling the third section; fifth section of costa longer than the third and fourth combined; crossvein r-m situated slightly beyond the basal one third of the discal cell; ultimate section of the fourth vein straight, last section of fifth vein about equal to the posterior crossvein in length (fig. 65b). *Abdomen:* Subopaque dusted with brownish to gray, first tergum and lateral margins of other abdominal segments gray; abdomen rather short and broad. Base of ovipositor thick and globose, piercer sharply pointed, slightly shorter than and gradually tapering from its base (fig. 65d).

Length: body, 2.8-3.3 mm.; wing, 3 mm.

Male unknown.

Type locality: Mount Washington, New Hampshire.

The writer has studied the type at the United States National Museum and has homotypes from the following localities: Emery, Utah, Aug. 16, 1929 (P. W. Oman) and Sapinero Canyon, Colo., Alt. 9,000 ft., Sept. 5, 1938 (D. E. Hardy, A. T. Hardy). Specimens apparently belonging here have been examined from: Custer, South Dakota, July 15, 1924, and 12 m. N. W. of Lusk, Wyo., July, 1895.

Dorilas (*Dorilas*) *varius* (Cresson)

(Plate 11, figs. 66a-f)

Pipunculus varius Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 309.

This species is well defined by its brown to black humeri, polished abdomen, chiefly yellow legs and yellow antennae. The male hypopygium is distinctive.

Male. Head: Front brownish gray pubescent, with a darker median spot; face silvery; occiput cinereous, brownish on upper portion; eyes joined on the front for about the length of the frontal triangle; mouthparts yellowish; first two antennal segments yellow-brown, third segment yellow to faintly brownish tinged, short acute (fig. 66a). *Thorax:* Subshining in ground color, mesonotum and scutellum brownish dusted above, grayed on the margins; pleurae and metanotum grayish; humeri brown to black; halteres yellowish, knobs brownish; propleurae each with a brush of nine to ten long yellow hairs on the hind margin; legs chiefly yellow, femora slender with distinct flexor bristles on apical portions; hind tibiae slightly bowed; posterior basitarsi equal in length to next three tarsal subsegments. *Wings:* Iridescent tinged; third section of costa longer than the fourth, stigma completely filling the third section; fifth costal section about equal in length to the third and fourth combined; crossvein r-m situated beyond the end of the subcostal vein

and almost at the middle of the discal cell; last section of the fourth vein nearly straight, with a faint curvature, apical cell narrowly open in wing margin (fig. 66e). *Abdomen:* Somewhat rounding on the sides, widest at segments three and four; polished black on the apical portions of terga three to five, bases of terga opaque brownish; first segment grayish. The extent of the opaque and polished areas of the abdomen varies from almost entirely polished on segments two to five with only extreme bases of segments opaque, to entirely opaque on the second tergum and the broad bases of other segments. Fifth segment of abdomen one and one half the length of the fourth; hypopygium about three fourths the length of the fifth. *Hypopygium:* Asymmetrical with a distinct apical cleft, seventh tergum just barely visible on the left side; ninth segment sometimes plainly seen on the right side, from dorsal view (fig. 66e). Ninth segment and harpagones yellowish; harpagones symmetrical, rather short, stout and bluntly square tipped from side view (fig. 66f). From ventral view most of the eighth segment is membranous, the membranous area extending to the base of ninth segment. Ninth segment rounding at apices, with a deep 'V' shaped cleft in middle on posterior margin. Harpagones broad at bases and acutely pointed at apices, from this view (fig. 66d).

Length: body, 3.2 mm.; wings, 3.8 mm.

Female. Front cinereous on lower half, polished black on upper portion; widest in the middle, gently narrowed toward the vertex; occiput entirely yellow; femora sometimes with faint median discolorations. Base of ovipositor rather globose, faintly tuberculate beneath; piercer about as long as and gradually tapering from its base (fig. 66b). The end of the piercer usually extends to about the base of the abdomen due to the folding down of the apex of the abdomen. Otherwise like the male.

Type locality: Harrisburg, Pa.

The writer has studied the type at the Cambridge Museum of Comparative Zoölogy and has homotypes from the following localities: Glencarlyn, Va., July 7 (Banks); Holliston, Mass., Aug. 10 (N. Banks); Chesapeake, Beh., Md., Sept. 21, in Marsh (N. Banks); Falls Church, Va., May 16 (N. Banks); Moab, Utah, Aug. 23 1938 (G. F. Knowlton, F. C. Harmston). Other material has been examined from the following states and Canadian provinces: British Columbia, Florida, Michigan, Missouri, New Brunswick, New York, Ohio, Ontario, Utah, and Wyoming.

Dorilas varius var. *mainensis* (Cresson)

Pipunculus mainensis Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 298. New combination.

Examination of the types showed that these were structurally the same species and study of a large series of specimens has proved it to be a rather variable species; all degrees of intergradation between these have been observed. The two varieties may best be separated by the third antennal segment being yellow in typical *varius* and black in *varius mainensis*. The latter usually slightly larger; the abdomen usually more opaque and the femoral rings more distinctly black. The membranous apex of hypopygium is large and distinct, not small as in var. *phaethus*.

Length: body, 3.5-4 mm.; wing, 4-4.4 mm.

Type locality: Fort Kent, Maine.

The writer has examined the type at the Boston Society of Natural History, and has homotypic females from Pingree Park, Colo., Aug. 14, 1934, 9,200 ft. (C. W. Sabrosky) and Brownsville, Texas, 7-3-38, (R. H. Beamer). It has also been identified from a number of localities in the following states and Canadian provinces: Alberta, Arizona, British Columbia, California, Idaho, Michigan, Nevada, Utah, and Washington.

Dorilas varius var. *phaethus* (Hardy-Knowlton)

Pipunculus varius var. *phaethus* Hardy-Knowlton, 1939, Ann. Ento. Soc. Amer. XXXII; 123-124.

This variety is distinguished by having the antennae entirely black and the apical depression of hypopygium very small. Following is the original description:

"Male. Second segment of antennae short acute, black with two to three hairs above and a number of short bristles below; third segment brownish, white fringed on margins; arista pale yellow basally, otherwise shining black. Halteres yellow, knobs slightly darker.

"Mesonotum and scutellum subshining with fine brownish yellow pubescence, lateral margins, humeri, pleurae and metanotum cinereous. Coxae shining black, trochanters yellow; femora, tibiae and tarsi chiefly yellow, femora with broad black rings at their middles, tarsal segments four and five slightly brownish. Middle trochanters with a long yellow hair above. All femora with a row of fine yellow hairs on the sides slightly dorsal (these are sometimes difficult to discern); femoral spines developed on anterior half, posterior tibiae slightly arcuate.

"Abdomen chiefly shining black, first segment cinereous, second segment opaque basally, subshining apically, other segments polished and metallic. Hairs of lateral comb on first segment yellow (on one paratype the combs are black). Hypopygium shining but slightly dusted, compressed to the right;

rather small from dorsal view. Ventral processes developed, reaching to base of fifth segment. Hypopygium with an apical cleft barely visible in dorsal view.

"Wings hyaline with a slight iridescent tinge; ultimate section of fourth vein straight or nearly so. Last section of fifth vein slightly sub-equal to posterior crossvein. Anal cell with a long petiole. Crossvein r-m slightly beyond end of auxiliary vein and basal one-third of discal cell.

"Length: wing, 4.5-5 mm.; body approximately 4 mm.

"Female unknown."

Type locality: Paradise, Utah.

Type in United States National Museum.

Dorilas (*Eudorylas*) *vierecki* (Malloch)

(Plate 11, figs. 67a-f)

Pipunculus vierecki Malloch, 1913, Proc. U. S. Nat. Mus. 43, 654-655.

This species is easily recognized by its yellow legs and halteres, its long acuminate antennae and large size. It is related to *atlanticus* (Hough) and *varius* (Cresson).

Male. Large, almost entirely bare species. *Head:* Exceptionally large, about equal or slightly larger than thorax. Eyes joined for about the length of the frontal triangle, very narrowly separated above and below; face and front opaque black in ground color, entire face and that portion of frontal triangle just above antennae densely silvery pubescent; upper portion of triangle bare, except for a few pale microscopic hairs on eye margins; occiput rather broad, subshining black in ground color, lightly gray dusted; antennae bright yellow, except brown to black third section of arista; bristles of second antennal segment short and black; third segment long acuminate, densely white pubescent (fig. 67a). *Thorax:* Mesonotum and scutellum subopaque black in ground color, densely covered with microscopic yellow-brown scales, replaced by grayish scales on the margins; scutellum faintly rugose; pleurae and metanotum cinereous, pleurae yellowish tinged in ground color; propleurae bare; humeri brown to black with yellowish margins; halteres yellow; legs bright yellow, coxae brown, tarsi faintly brownish tinged; femora moderately thickened with the flexor bristles well developed on apical halves; posterior tibiae arcuate; posterior basitarsi longer than the next three tarsal subsegments. *Wings:* Lightly iridescent; third costal section slightly shorter than the fourth, stigma not quite filling third section; fifth costal section about equal to third and fourth combined; crossvein r-m situated just beyond the end of the subcostal vein and at about the basal one third of discal cell; last section of fourth vein faintly curved (fig. 67d). *Abdomen:* Subopaque in ground color, heavily dusted with brown to gray; first

tergum and margins of other segments gray, this gray pollen extending for a short way up into the dorsum on posterior margins; hind margin of fifth segment only narrowly marked with brown in the middle. Abdomen rather short and rounding on the sides, broadest at segment three; fifth segment about one third longer than the fourth; hypopygium about three fourths the length of the fifth segment. Hypopygium subquadrate in outline with a large apical depressed area; seventh tergum scarcely visible from above (fig. 67e); ninth segment and harpagones yellowish. From ventral view the membranous area of the eighth segment is very extensive, with a broad band of sclerite separating it from ninth segment. Ninth segment about as broad as long, cleft on hind margin, broadly 'V' shaped and extending about two thirds the length of segment on a middle line. Harpagones very broad, bluntly rounded apically. Cerci only moderately developed, extending just beyond apex of ninth (fig. 67f).

Length: body, 4.5-5.1 mm.; wing, 5-5.4 mm.

Female. Eyes narrowly separated on the front, frontal stripe slightly widened in the middle; front cinereous on lower half, grayish to subshining black on upper portion. Sides of abdomen more cinereous than in male. Base of ovipositor short, somewhat rounding with a very distinct projection at about the middle below; piercer long and slender, over two times as long as, and abruptly terminating its base (fig. 67c); tip of piercer extending to the base of the abdomen. The specimens studied have been slightly smaller than the male.

Length: body, 3.8-4 mm.; wing, 4-4.2 mm.

Type locality: Plummers Island, Maryland.

The writer has examined the type at the United States National Museum and the description of the male is based upon a homotype. Specimens have been identified from Holliston, Massachusetts, July 10 (N. Banks); Raleigh, N. C., 24-VI-30 (C. S. Brimley) and Madison C., Texas, June 23, 1934 (H. J. Reinhard).

Dorilas willistoni (Kertesz)

Pipunculus willistoni Kertesz, 1900, Wiener Ent. Zeit. XIX, 244. Change of name.
Pipunculus aculeatus Williston, (nec Loew), Bio. Cent. Amer. III, 89.

This species cannot be acurately placed from the original description and until the type can be studied, its position will remain doubtful; it appears to be related to *vierecki* (Malloch) and *pallipes* (Johnson) but as so many of the characters are questionable no attempt has been made to incorporate it in the key to the species of *Dorilas*. The following is the original description:

"Face black, densely silvery-pubescent. Front black, lightly pollinose. First two joints of antennae black; the third joint lightly yellow, produced below into a slender point. Thorax black, brownish-pollinose on the dorsum, gray-pollinose on the pleurae. Abdomen shining black; first segment and the lateral margins of the following segments opaque gray-pollinose. Wings nearly hyaline; penultimate section of the fourth vein more than twice the length of the antepenultimate section.

"Length 3 millim.; of the wings, 4 millim."

Type locality: México, Teapa in Tabasco.

Type probably in British Museum.

Collinias Aczel

Collinias Aczel, 1940, Zoöl. Anzeiger, 1.12. Bd. 132, Heft 7/8, 151.

This genus is characterized by having the third costal section closed by a supernumerary crossvein; the stigma is short, not filling the third section; the propleurae each possess a fan of long hairs; the base of the abdomen is transparent yellow in all known species. *Collinias* are apparently confined to the Australian region.

Genotype: *Collinias heterostigmus* (Perkins), 1905.

Claraeola Aczel

Claraeola Aczel, 1940, Zoöl. Anz. 1.12. Bd. 132, Heft 7/8, 151.

This genus is characterized by the well-developed posterior lobe of the wing; the small obtuse third antennal segment, third scarcely larger than the second; vein M_{1+2} forked, M_2 present as an appendix of the fourth vein. The propleurae are bare, stigma present in wing, third costal section almost as long or longer than the fourth and the abdomen usually entirely opaque. This contains one large species from Formosa, 7.5-8 mm.

Genotype: *Claraeola adventitia* (Kertesz), 1912.

Beckerias Aczel

Beckerias Aczel, 1939, Dorylaiden-Studien IV, Zoologischer Anzeiger, 1.6. Bd. 126, Heft 7/8, 191-195.

This genus has been erected to contain a remarkable Hungarian species with a rudimentary anal vein; it is well defined in that the anal vein (A_1) is either completely lacking or but a stump of the vein is present in the wing base at the junction of anal and cubitus. To date but a single species is known in this genus; it is one of the few known genera which apparently do not occur in the New World.

Genotype: *Beckerias pannonicus* Aczel; type locality: Komitat Zala, Hungary.

Anacephalops Aczel

Anacephalops Aczel, 1940, Zoöl. Anz. 1.12. Bd. 132, Heft 7/8, 151.

This genus is characterized by having vein M_{1+2} forked, vein M_2 present as an appendix on fourth vein and stigma absent in the wing. This is the only known genus possessing this combination of characters.

Genotype: *Anacephalopa amboinalis* (Walker), 1861.

Allomethus n. genus

The species in this genus are characterized by having no stigma in the wing, posterior lobe moderately developed; crossvein r-m situated near basal part of discal cell; eyes of the male holoptic and the abdomen gently tapering posteriorly; hypopygium small, rather inconspicuous; third segment of antennae acute to obtuse or rounding below. The genus is related to *Tömösváryella* and *Dorylomorpha;* it differs from the former in the position of crossvein r-m, the shorter third antennal segment and peculiar form of the hypopygium as well as the more elongate wings. The genus differs from *Dorylomorpha* in having the eyes of male joined on the front; acute to obtuse third antennal segment; abdomen tapering and hypopygium small instead of abdomen clavate and hypopygium swollen as in *Dorylomorpha.* The legs are yellow in the three species included here; this may or may not be characteristic of the genus.

Genotype: *Allomethus brimleyi* n. sp.

KEY TO SPECIES

1. Third costal section elongate, two to three times the length of the fourth..... 2
   Third costal section short, about one third the length of the fourth section; antennae yellow, third segment obtuse; abdomen opaque brownish...*flavicornis* (Williston), p. 129
2. Entirely opaque species; third antennal segment broadly obtuse to rounding below, brownish in color; humeri brownish black.....*brimleyi* n. sp., p. 128
   Abdomen shining black, lateral margins in part yellowish; third antennal segment acute, yellowish in color; humeri yellow.....*xanthopodus* (Williston), p. 130

Allomethus brimleyi n. sp.

(Plate 11, figs. 68a-c)

This species is apparently related to *flavicornis* (Williston) and *xanthopodus* (Williston) but is strikingly different from these, as well as from all other known Dorilaidae. It is most easily recognized by its minute hypopygium, yellow legs, obtuse third antennal segment and characteristic wing venation.

Male. Entirely opaque, thinly pilose species. *Head:* Eyes joined for almost two thirds the length of the front; frontal triangle, above antennae, opaque velvety black; face brownish to gray pubescent;

mouthparts yellow; antennae brownish with a faint tinge of yellow; third segment small, scarcely twice the size of the second, broadly obtuse to rounding below (fig. 68a); aristae distinctly three segmented; occiput rather narrow; entirely gray pollinose, rather thinly so above, with the black ground color showing through. *Thorax:* Mesonotum and scutellum opaque brown; metanotum grayish brown dusted; pleurae opaque brownish with a distinct tinge of yellow; humeri brownish black, stems pale; propleurae bare; coxae of legs brown to black, legs otherwise yellow; femora slender with two rows of weak spines below on the apical portions of the posterior pair; posterior basitarsi equal in length to the remaining tarsal subsegments. *Wings:* Brownish tinged, iridescent, no discernible stigma; third section of costa elongate, five to six times as long as fourth section; costal margin of third section strongly swollen; fifth section of costa longer than third and fourth combined; crossvein r-m situated at or slightly before the end of the subcostal vein and at the basal one fourth of discal cell; R_5 almost straight, but faintly curved as it runs from r-m crossvein to apex of the wing; last section of fourth vein (M_{1+2}) straight (fig. 68b); posterior lobe distinct. *Abdomen:* Opaque brown, first segment dusted with gray, apical margins of segments two to five very faintly gray fasciated. Sides of abdomen rounding, widest at segments two to three. Hypopygium very minute, scarcely visible from above, about one fifth the length of the fifth segment, rather symmetrical with an apical depression on the right side (fig. 68c).

Length: body, 3.8-4.2 mm.; wing, 4.7-5 mm.

Female unknown.

Holotype ♂, Raleigh, North Carolina, Aug. 6, 1924 (C. S. Brimley); one paratype ♂ same locality and collector, July 19, 1935.

Types are in Snow Entomological Collection.

Allomethus flavicornis (Williston)

(Plate 11, fig. 69a)

Pipunculus flavicornis Williston, 1892, Bio. Cent. Amer. III, 89.

The generic position of this species is not certain. It cannot be placed from the original description. According to the notes made by Doctor John Smart, of the type female in the British Museum, it appears to belong in *Allomethus*. Specimens in the United States National Museum collection determined *flavicornis* proved to be females of *Dorilas pallipes* (Johnson). The following is the original description:

"Front very narrow, the sides unusually convergent above; the ground-colour black, but covered, like the face, with silvery pubescence, less distinctly so above. Antennae light yellow; third joint obtusely pointed below, ovate; arista black. Thorax black, the dorsum dark brown-pollinose; pleurae silvery. Abdomen opaque coffee-brown; segments two to six broadly opaque silvery-grey on the sides, an interrupted posterior band, more brownish in colour, extending across them; first segment grey, narrowly brown in front; ovipositor yellowish-red. Legs light yellow, including the coxae, excepting only the terminal joint of the tarsi, which is blackish; the minute black spines, arranged in longitudinal rows, are conspicuous. Wings nearly hyaline; penultimate section of the fourth vein more than twice as long as the antepenultimate section; small cross-vein opposite the tip of the auxiliary vein. Length 5 millim.; of the wings, 6 mm."

The following notes are added from the observations of Doctor Smart: No stigma present in wing; third costal section short, about one third the length of the fourth section; crossvein r-m situated at about basal one third to one fourth of the discal cell (fig. 69a); humeri yellow.

Type locality: México, Amula in Guerrero.

Type in British Museum.

Allomethus xanthopodus (Williston)?

(Plate 11, fig. 70a)

Pipunculus xanthopodus Williston, 1892, Bio. Cent. Amer. III, 87-88.

From the original description *xanthopodus* appears to be related to *Dorylomorpha flavomaculata* (Hough) but the report of Doctor John Smart after studying the type in the British Museum proves it to be very different. Doctor Smart states that the r-m crossvein is situated near the base of the discal cell and wings without a stigma. These characters would indicate that it belong in *Allomethus* but as the hypopygium or the shape of the abdomen was not indicated it is placed here with a query until the type can be studied further. The following is the original description:

"The small frontal triangle and the face black, densely silvery-pubescent. Antennae: basal joints black, or blackish; third joint light yellow, in shape acutely pointed below; arista black, thickened at its base. Dorsum of thorax brown; pleurae and metanotum silvery-grey-pollinose. Abdomen shining black, the lateral margins in part yellowish; the first and second segments entirely, and the successively narrower sides of the third, fourth, and fifth segments, grey-pollinose, opaque. Legs, including the coxae in part, light yellow; femora stout, distally with a double row of short spines below. Wings nearly hyaline; anterior crossvein nearly opposite the tip of the auxiliary vein; ultimate section of the fourth vein sinuous, without stump; penultimate section about three times the length of the antepenultimate section. Length 5 millim.; of the wings, 7 millim."

The following can be added to the description from the notes of Dr. Smart: Crossvein r-m at about basal one fourth to one fifth of discal cell; third costal section of the wing twice the length of the fourth (fig. 70a); humeri yellow.

Type locality: México, Sierra de las Aguas Escondidas in Guerrero.

Type in British Museum.

Dorylomorpha Aczel

Tömösváryella (*Dorylomorpha*) Aczel, 1939, Zoöl. Anzeiger, Band 125, Heft ½, Zeit 22.

Dorylomorpha was proposed as a subgenus of *Tömösváryella* to include those species which have the r-m crossvein situated near the base of the discal cell. This is applicable to our North American species but should be raised to generic rank. Aczel acknowledged this ranking in his latest paper.[29]

The genus as here recognized takes in those species having no stigma in the wing; r-m crossvein in the basal one sixth to one fourth of the discal cell; eyes of male dichoptic, distinctly separated on the front. The posterior margin of the compound eyes is curved inward on upper half so that the occiput is broader, more swollen above. The abdomen is elongate and strongly swollen apically, clavate in both sexes especially from lateral view; all the known North American species are polished black in ground color. The third segment of the antennae is acuminately pointed and the third costal section is very short compared to the fourth.

This group appears to be intermediate between *Tömösváryella* and *Dorilas,* possessing many characters in common with both of these genera; the characteristics of the head, wings and abdomen make it distinctive.

Genotype: *Pipunculus rufipes* Meigen (of Europe.)

KEY TO MALES

1. Hypopygium symmetrical, without a distinct membranous depressed area at apex, never quadrate in outline 2
   Hypopygium more asymmetrical, with a distinct apical depression, or rather quadrate in outline with an indented area on the left side 3
2. Antennae bright yellow; third segment very long acuminate; femora chiefly yellow, with only narrow rings of black; ninth segment yellow ... *atramontensis* (Banks), p. 132
   Antennae entirely black; third segment short acuminate; femora mostly black, only apices yellow; ninth segment black ..... *tridentata* n. sp., p. 141
3. Femora chiefly black, only apices yellow; tibiae usually blackened 4
   Legs almost entirely yellow; femora never with more than narrow bands of black or median discolorations 7

29. 1940, Zoöl. Anz., 1.12. Bd. 132, Heft 7/8.

4. Eyes narrowly separated on the front; frons much narrower than width of ocellar triangle 6
Eyes widely separated; front at least as broad as ocellar triang'e..... 5

5. Harpagones strongly flattened laterally, and very irregular; outer harpagone curved downward at apex; the inner has a number of small tubercles on margins (fig. 77b); sixth tergum greatly developed, about equal to eigth segment and with a pair of fingerlike processes on posterior margin (fig. 77c); abdomen greatly swollen posteriorly ..... *ornata* n. sp., p. 139
Harpagones boot-shaped at apices, more equal in size and shape (fig. 74e); sixth tergum normal; addomen not so strongly swollen posteriorly.... *exilis* (Malloch), p. 136

6. Eighth segment rather quadrate in outline, with no distinct membranous area at apex but with an indented area on left side; harpagones slender at apices..... ..... *caudelli* (Malloch), p. 135
Eighth with a very distinct membranous depressed area extending almost to base of segment; harpagones expanded laterally at apices..... *uncinata* n. sp., p. 142

7. Legs entirely yellow; sides and venter of abdominal segments two to four broadly yellow; harpagones slender and rather acutely pointed... *flavomaculata* (Hough), p. 137
Femora blackened medianly; abdomen shining black except in occasional specimens of *canadensis* n. sp., harpagones not as above..... 8

8. Tibiae discolored medianly; harpagones boot-shaped, curved to the right at their apices from ventral view (fig. 76e)..... *occidens* (Hardy), p. 139
Tibiae entirely yellow; harpagones asymmetrical, the inner harpagones is trilobed and the outer is slightly enlarged at apex (fig. 72d); sides of segments three and four sometimes yellowish..... *canadensis* n. sp., p. 133

KEY TO KNOWN FEMALES

1. Abdomen shining black..... 3
Sides of abodminal segments two to four and entire venter yellow..... 2

2. Ovipositor strongly flattened dorsoventrally; third antennal segment black; femora blackened medianly ..... *canadensis* n. sp., p. 133
Ovipositor not so flattened, more rounding above; third antennal segment yellow to yellow-brown; femora usually completely yellow..... *flavomaculata* (Hough), p. 137

3. Ovipositor flattened dorsoventrally, base elongated..... 4
Base of ovipositor rounding, not flattened above..... 5

4. Third antennal segment long acuminate; trochanters and tibiae chiefly black; hind tibiae with numerous strong yellow hairs on dorsal surfaces near middles, *ornata* n. sp., p. 139
Third segment short acuminate; trochanters and tibiae yellow; hind tibiae lacking the strong dorsal hairs..... *tridentata* n. sp., p. 141

5. Tibiae and tarsi chiefly black; all tibiae armed with strong median bristles, apical bristles strong on front and middle tibiae..... *exilis* (Malloch), p. 136
Tibiae and tarsi chiefly yellow; tibial bristles weak..... 6

6. Piercer of ovipositor distinctly articulated with its base; base rather tuberculate below and elongate (fig. 79d)..... *uncinata* n. sp., p. 142
Piercer not distinctly articulated with base; base subglobose, more rounding and without tubercle (fig. 73e)..... *caudelli* (Malloch), p. 135

Dorylomorpha atramontensis (Banks)

(Plate 11, figs. 71a-b)

Pipunculus atramontensis Banks, 1911, Trans. Amer. Ent. Soc. XXXVI, 312.

Male. Head: Antennae bright yellow, third segment very long acuminate (fig. 71b); eyes very narrowly separated, front shining on upper two thirds, silvery on lower one third. *Thorax:* Subshining black, lightly brownish gray dusted; humeri black, halteres yellow; propleurae bare; legs yellow, femora with rather narrow

black rings near their bases. These are much wider on the hind femora; femora slender, spines weak. *Wings:* Iridescent; third costal section short, one fifth to one sixth the length of the fourth; stigma absent; ultimate section of fourth vein but faintly curved; crossvein r-m situated near the base of discal cell. *Abdomen:* Polished black, very faintly dusted; rather long and swollen greatly toward the apex, as seen from lateral view. Hypopygium symmetrical, but slightly compressed to the right and with no distinct depression; slightly shorter than fifth segment in length (fig. 71a); ninth segment and harpagones yellowish.

Length: body, 5.0 mm.; wings, 5.6 mm.

Female unknown.

Type locality: North Fork of Swannannoa River, Black Mts., North Carolina.

The writer has examined the type and paratype at the Cambridge Museum.

Dorylomorpha canadensis n. sp.

(Plate 12, figs. 72a-f)

This species is related to *tridentata* by the genital characters and to *flavomaculata* by the coloring of the females and occasional male specimens. The inner harpagones of the male is characteristic because of the moderately developed ventral lobe and the strong lateral and apical lobes. The outer harpagone enlarges at the apex, instead of tapering to an acute point as in the two above species. The females are distinguished from *tridentata* by having the sides of abdominal segments three and four largely yellow and the black bands of the femora not so broad; they are distinguished from *flavomaculata* by the strongly compressed ovipositor, the black antennae and blackened femora.

Male. Head: Eyes narrowly separated on the front, the median portion of the front being scarcely wider than the median ocellus; upper half of front shining black, lower portion silvery pubescent; middle portion of front somewhat convex longitudinally; antennae moderately acuminate (fig. 72a), rather thickly white pubescent; mouthparts yellow; hind margins of compound eyes indented on upper halves, so that the occiput is much broader on upper portions. *Thorax:* Polished black in ground color, very lightly dusted on the sides and metanotum; dorsocentral hairs very weak; humeri black, halteres bright yellow. *Legs:* Coxae black with yellow apices, trochanters, tibiae and tarsi entirely yellow, femora chiefly so but blackened medianly, the blackness being more extensive on the dor-

sal surfaces of the femora and slightly interrupted with yellow on lower surfaces. Hind trochanters slightly swollen below; femora moderately developed, spines absent. Tibiae almost straight, apical bristles of front pair moderate. *Wings:* Iridescent, with a somewhat dusky appearance. The third section of costa is about one fourth as long as fourth section; fifth section about equal to the third and fourth combined; crossvein r-m situated near the basal one fifth of discal cell and beyond end of subcostal vein; ultimate section of fourth vein very slightly curved. *Abdomen:* Polished black in most specimens; a few individuals are on hand which have the sides of segments three and four yellowed, as in *flavomaculata.* Abdomen greatly enlarged posteriorly, especially as seen from lateral view. Fifth terga about one and one third times the length of fourth. *Hypopygium:* About three fourths the length of the fifth abdominal segment, slightly compressed to the right and with a conspicuous apical membranous area (fig. 72e). From ventral view the sixth tergum is greatly developed, larger than the eighth segment and serves to give support to the genital chambers; its inner margin is produced into a large lobe that fits beneath the harpagones; this is concave on its ventral surface. The seventh tergum is comparatively narrow with its inner margin terminating in a beaklike apex and its posterior margin rather strongly curved (fig. 72b). The membranous portion of the eighth extends more than half the length of the segment on a middle line. The ninth segment is scarcely longer than wide with a 'U' shaped cleft on anterior margin. Inner harpagone trilobed, with large rounding lateral and apical lobes and a smaller ventral lobe; the outer harpagone is thick at base, slightly enlarged at apex and concave on inner margin (fig. 72d). Cerci small, not greatly developed.

Length: body, 3.8-4 mm.; wings, 4.8-5.1 mm.

Female. Front broad, wider than ocellar triangle, polished black on upper half to two thirds, pubescent below; median portion of front convex as in male. Sides of abdominal segments two to four and all of the venter, bright yellow, interrupted on the dorsum by broad black spots. Ovipositor yellowish to red in color, base strongly flattened dorsoventrally (fig. 72c), piercer about equal to its base in length and distinctly articulated; piercer somewhat tuberculate near base below (fig. 72f).

Length: body, 3.6 mm.; wing, 4.3 mm.

Holotype ♂ : Cypress Hills, Sask., June 4, 1939 (A. R. Brooks). Allotype ♀ and twenty eight paratypes, nineteen ♂ ♂ , nine ♀ ♀ same data as type.

Holotype, allotype and fifteen paratypes returned to the Canadian National Museum, others retained in Snow Entomological Collection.

Dorylomorpha caudelli (Malloch)

(Plate 12, figs. 73a-g)

Pipunculus caudelli Malloch, 1913, Proc. U. S. Nat. Mus. 43, 298-299.

This species is related to *exilis* (Malloch) but can be separated by the characters given below.

Male. Head: Eyes dichoptic narrowly separated on the front; front silvery directly above antennae, shining black on upper one half to three fourths, front convex, slightly swollen and protruding above the eye height; antennae brown to black, third segment long acuminate (fig. 73a), white at the tip and covered with dense fine white pile. *Thorax* and abdomen shining, very lightly pruinose with fine white, sparsely distributed pile; humeri black, stems of halteres yellow, knobs faintly brown; coxae, trochanters and femora black, apices of femora yellow; tibiae and tarsi chiefly yellow, with a narrow ring of black on the tibiae; hind tibiae gently arcuate. *Wings:* Lightly iridescent; third costal section one fourth to one fifth the length of the fourth, stigma absent (fig. 73d); crossvein r-m situated at basal one sixth of discal cell, before the end of the subcostal vein; ultimate section of fourth vein slightly sinuate; last section of fifth vein equal in length to posterior crossvein; petiole of cubital cell comparatively long. *Abdomen:* Entirely shining to faintly brown dusted, without any signs of fasciae; sides almost straight, abdomen gently enlarging posteriorly, being broadest at segment five. Seventh selerite scarcely visible from external, dorsal view; hypopygium rather small when viewed directly from above, eighth segment somewhat quadrate, with a distinct indented area on left side of apex; no distinct membranous area (fig. 73f). Ninth segment broad, about as wide as long, rounding at apices and with a small "U" shaped cleft on posterior margin in middle. Harpagones rather slender, acutely pointed at apices (fig. 73c). Ninth segment and harpagones yellow; hypopygium one fourth to one fifth the length of the fifth segment. From lateral view the abdomen is distinctly clavate (fig. 73g).

Length: body, 3.5 mm.; wing, 4 mm.

Female. The eyes are widely separated, the front at least as wide as ocellar triangle for its entire length, widest at middle portion and with a shining black elevated area extending longitudinally to about the lower one third. Lower third of front, entire face and narrow stripe extending dorsad along eye margins, silvery pubescent. Slen-

der tip of third antennal segment even longer than in the male. Bases of hind femora yellow. Base of ovipositor black, rather subglobose, not flattened dorsoventrally (fig. 73b); piercer yellow, about equal to its base (fig. 73c) and extending just beyond posterior margin of the third abdominal segment. Otherwise like male.

This is the first report of the female of this species.

Type locality: Kaslo, British Columbia, Canada.

The description of the male is based upon the type in the National Museum Collection.

Added distribution: Port Renfrew, British Columbia, June 22, 1901; Vancouver, B. C., May 20-24, 1906 (R. V. Harvey, R. S. Sherman); Burke Falls, Ontario, July 9, 1926 (F. P. Ide).

Dorylomorpha exilis (Malloch)

(Plate 12, figs. 74a-e)

Pipunculus exilis Malloch, 1913, Proc. U. S. Nat. Mus. 43, p. 295.

This species is related to *caudelli* (Malloch) but is distinguished by the broad front of the male, the blackened tibiae and tarsi as well as genital characters.

Male. Rather bare species with only scattered pale hairs on thorax and abdomen. *Head:* Front scarcely narrowed, almost as wide toward vertex as that portion just above the antennae; shining black on upper half, silvery below; front with a convex ridge on upper portion which extends the shining black into the upper median part of the silvery area; face dull grayish, broader than front; mouthparts yellow-brown; third segment of antennae long acuminate (fig. 74a), brown with dense silvery pubescence; second segment with only weak bristles; occiput subshining black above, cinereous on the sides and lower portions, eyes indented above, causing occiput to be broader on upper portion. *Thorax* and abdomen shining black, very faintly dusted with brownish and covered with scattered pale pile; metanotum and pleurae gray dusted; legs chiefly black, only extreme apices of femora and tibiae and bases of tibiae yellow, tarsi yellow to brownish; femora slender with no distinct bristles or flexor spines; front and middle tibiae with moderately strong apical bristles below; hind tibiae arcuate; basitarsi about equal to next three tarsal subsegments in length. *Wings:* Hyaline, only faintly iridescent; third section of costa short, one fourth to one fifth the length of the fourth section; fifth section of costa shorter than third and fourth combined, scarcely longer than fourth section; crossvein r-m situated at about end of subcostal vein and at basal one fifth of discal cell; ultimate section of fourth vein strongly sinuate, last section of fifth

vein about equal to posterior crossvein in length (fig. 74c). *Abdomen:* Elongate, broad apically, widest at segment five. Hypopygium rather small, somewhat symmetrical, about one fourth the length of segment five and with a small apical depression on the right (fig. 74d). Ninth segment black, harpagones yellow. From ventral view the ninth segment is slightly longer than broad, longer than the sclerotized portion of the eighth segment and with a distinct indentation near base on outer margin; hind margin of ninth with a small "U" shaped cleft in the middle. Harpagones very irregular, the inner margins nearly straight but the outer margins greatly curved, the apices produced bootshaped; the outer margins are developed into obtuse to acute points just above middles (fig. 74e).

Length: body, 3-3.5 mm.; wings, 4-4.5 mm.

Female. Front wider than ocellar triangle, polished black on upper two thirds, silvery below; posterior tarsi strongly flattened. Base of ovipositor rather elongate with a slight tubercle near apex below; piercer about as long as base (fig. 74b). This is the first report of the female.

Type locality: Medicine Hat, Alberta, Canada.

The writer has examined the type in the National Museum Collection and has homotypic specimens from: Buck Creek, Wyo., Sept. 14, 1895 (W. M. Wheeler); Walden, Colo., Aug. 20, 1931 (H. T. Peters); Big Horn Co., Timber Line, Wyo., Aug. 1910; and Logan Canyon, Utah, Aug. 28, 1938 (D. E. Hardy, G. S. Stains). Specimens have also been identified from the following states and Canadian Provinces: Alberta, California, Colorado, Michigan, New Mexico, Saskatchewan and Utah.

Dorylomorpha flavomaculata (Hough)

(Plate 12, figs. 75a-f)

Pipunculus flavomaculata Hough, 1899, Proc. Bost. Soc. Nat. Hist. XXIX, 85.

This is a very striking species easily recognized by the yellow sides and venter of abdominal segments two to four.

Male. Almost bare species, with very sparse pale pile on dorsum of thorax and abdomen. *Head:* Eyes dichoptic, front rather narrowly separated from median portion to ocelli; silvery on lower one half, shining black above; front convex, slightly gibbose in the middle; occiput subshining black above, cinereous below; posterior margin of eyes markedly curved inward on upper one half of head, from lateral view, causing the occiput to be wider and much more swollen above; third antennal segment yellow-brown in ground color covered with dense white pubescence, acuminate; bristles of second segment

weak (fig. 75a); mouthparts yellow. *Thorax:* Mesonotum subshining brownish in ground color, lightly pruinose, faintly grayed on margins and on pleurae and metanotum; humeri black, halteres bright yellow; legs slender, entirely yellow, femora with only very weak spines beneath toward their apices. *Wings:* Faintly iridescent; third costal section very short, one third to one fourth the length of the fourth section; fifth section much longer than third and fourth together; crossvein r-m situated slightly before end of subcostal vein and at basal one sixth or seventh of discal cell; third section of fourth vein longer than last section, last section slightly curved; last section of fifth vein shorter than posterior crossvein; petiole of cubital cell short (fig. 75b). *Abdomen:* Polished with only first tergum cinereous; lateral margins and sterna of segments two to four yellow, otherwise brown to black; sometimes the yellow extends toward the dorsum so that only a broad stripe of black remains; fifth segment shining black. Abdomen rather slender, greatly enlarged apically as seen from lateral view (fig. 75f), widest at segment five from above. *Hypopygium:* About as long as fifth segment, asymmetrical, triangular, rather pointed apically, and with a distinct depressed area on the right side of the apex from dorsal view (fig. 75e). From ventral view the membranous area covers the entire apex of the eighth segment. Ninth segment yellow-brown, harpagones bright yellow; ninth segment longer than the sclerotized portion of the eighth segment, from base of ninth to membranous portion; ninth with a small "U" shaped cleft on hind margin. Harpagones rather asymmetrical; the outer harpagone is elongate and slender, somewhat tapering and curved inward at apex; inner harpagone thick at base and with an acute point on its outer apex (fig. 75d).

Length: body, 4 mm.; wings, 4 mm.

Female. Front much wider than in male, shining black on upper one half, silvery below, occiput very wide on upper portion. Femora faintly discolored on upper portions near bases. Abdomen more slender, not so swollen apically as in male, widest at segments five and six. In some specimens the abdomen is almost entirely yellow, with only a narrow stripe of black down the dorsum. Ovipositor reddish, piercer and base distinctly articulated; base somewhat rounding, piercer about equal to it in length; piercer enlarged basally with a constriction between it and the ovipositor base on the upper margin; piercer gradually tapering, extending to about the base of fourth abdominal segment (fig. 75c). Slightly smaller than male.

Length: body, 3.7 mm.; wing, 3.8 mm.

Type locality: Massachusetts.

Type in the Field Museum at Chicago.

The writer has examined the type and has seen specimens from North Beach, L. I., N. Y. 5-24-1924 (F. M. Schott); Highspire, Pa., 4-28 (N. Banks); Sandusky, Ohio, July 18, 1904 (J. S. Hine); Downie Creek, Selkirk Mts., B. C., Aug. 14, 1905 (J. C. Bradley); Hampton, N. H. (S. A. Shaw); Brookline, Mass., May 23 (Johnson); Gloucester, Mass., June 19; Berlin, Mass., Aug. 8, 1915 (C. A. Frost); Auburndale, Mass., May 22, 1904 (Johnson); Barber Dam, N. B., June 25, 1914 (J. D. Tothill) and Lake Tahoe, Calif., Aug. 11, 1940 (D. E. Hardy).

Dorylomorpha occidens (Hardy)

(Plate 13, figs. 76a-e)

Pipunculus atramontensis occidens Hardy, 1939, Jour. Kans. Ento. Soc. 12, 17-18. New combination.

This was described as a variety of *atramontensis* (Banks) but upon examining the type of the latter the writer found *occidens* to be a distinct species. It appears to be related to *atramontensis* but the male hypopygium places it in another group of *Dorylomorpha*. It is easily distinguished by having the antennae black, third segment not so long acuminate (fig. 76a), and hypopygium not so symmetrically developed and with a distinct membranous apical depressed area (fig. 76c). The apical portion of the abdomen is also more swollen from lateral view (fig. 76d) and the specimens are slightly smaller in size. This species differs from *flavomaculata* (Hough) in having the abdomen entirely shining black, femora with black rings, tibiae discolored medianly; hypopygium shorter, not so pointed. From ventral view the membranous portion of the eighth segment occupies a small area at apex; sclerotized portion of eighth much longer than length of ninth segment. Ninth about as broad as long, the cleft on the hind margin is "U" shaped and extends about one third the length of the segment. Harpagones irregular, their apices produced bootlike toward the right (fig. 76e).

Length: body, 3.5-3.7 mm.; wings, 4.5-4.7 mm.

Female unknown.

Type locality: Potlatch, Idaho.

Type in United States National Museum.

Dorylomorpha ornata n. sp.

(Plate 13, figs. 77a-f)

This species is related to exilis (Mall.) by external characters. The abdomen is more strongly swollen and the sixth abdominal ter-

gum is greatly developed and forms a receptacle for the harpagones. The harpagones are strongly flattened laterally; the outer harpagone is greatly curved downward and the inner is very irregular in shape but not so curved. The females are related to *tridentata* n. sp. but are distinguished by the long acuminate third antennal segment, more blackened legs, stronger dorsocentral hairs and the long dorsal bristles on the hind tibiae. The females are distinguished from *exilis* by the strongly flattened ovipositor.

Male. Head: Eyes widely separated on the front; front about as wide as ocellar triangle; polished black on upper two thirds, silvery below; front with a longitudinal convexity down its middle; antennae black, bristles of second segment weak, third segment very long acuminate (fig. 77a); occiput broad on upper portion, about one third as wide as the compound eye; face slightly convex, mouthparts yellow. *Thorax:* Polished black in ground color, dusted with brownish pollen on the dorsum, lightly grayed on sides and metanotum; dorsocentral and marginal hairs rather strong and yellow; humeri black, halteres bright yellow. *Legs:* Chiefly black, apices of femora, bases and apices of tibiae and first three subsegments of tarsi yellow; femora moderately developed, with only weak bristles, hind tibiae gently arcuate slightly enlarged toward the apices and with numerous strong yellow hairs on dorsal surfaces near middles. *Wings:* Darkly iridescent; hairs along costal margin rather strong. Third costal section one fourth to one fifth the length of fourth; fifth section longer than third and fourth combined; crossvein r-m situated at about basal one fifth of discal cell, ultimate section of fourth vein slightly curved. Abdomen polished black. *Hypopygium:* The sixth tergum is strongly developed, about equal in size to the eighth segment, the inner margin is produced into a large concave lobe upon which the harpagones rest in normal position. The posterior margin of the lobe possesses two fingerlike projections. The seventh tergum is more narrow and ends in an acute point on its inner margin (fig. 77c). The eighth segment has a large membranous depression at its apex, from ventral view this extends about as wide as long with a shallow "V" shaped cleft on hind margin. Harpagones about equal to the ninth segment in length, very asymmetrical and irregular (fig. 77d, e); both are strongly compressed laterally; the outer is developed into two main lobes and strongly curved downward at its apex (fig. 77b); the inner harpagone has a number of small projections on both inner and outer margins. Cerci very small, not greatly developed.

Length: body, 3 mm.; wing, 4 mm.

Female. Front wider than ocellar triangle, abdomen not so strongly swollen posteriorly as in male. Ovipositor flattened dorsoventrally. Piercer about equal to length of base with a square topped swelling on underside near base (fig. 77f).

Length: body, 3.7 mm.; wing, 4.5 mm.

Holotype ♂ : Clinton, B. C., June 11, 1938 (J. K. Jacob); allotype and one paratype ♀, same locality and collector as type, June 15, 1938, and one paratype ♀, Chilcotin, B. C., June 18, 1920 (E. R. Buckell).

Holotype, allotype and one paratype returned to Canadian National Museum; others in Snow Entomological Museum.

Dorylomorpha tridentata n. sp.

(Plate 13, figs. 78a-h)

This species is related to *atramontensis* (Banks) in that the hypopygium of the male is symmetrical, with no distinct apical depressed area. It is readily distinguished by having the antennae black, third segment not so long acuminate; femora mostly black, with only apices yellow; third costal section of wing about one third the length of the fourth and ninth segment black instead of yellow as in *atramontensis*.

Male. Almost entirely bare species, thorax and abdomen but sparsely haired. *Head:* Eyes narrowly separated on the front; front silvery on lower one third, shining black on upper two thirds; face silvery pubescent, slightly gibbose on lower portion; mouthparts yellow, palpi terminating in long slender points; antennae black, hairs of second segment very weak; third segment short acuminate (fig. 78a); occiput cinereous, rather broad on upper portion, narrowed on lower part. *Thorax:* Shining black ground color, mesonotum lightly dusted with brown; dorsocentral hairs present but weak; scutellum mostly polished; propleurae bare; humeri black; halteres bright yellow. *Legs:* Coxae black, trochanters yellow; femora black except for yellow apices; tibiae and tarsi yellow, tibiae sometimes faintly discolored medianly, last two tarsal subsegments yellow-brown; pulvilli slender, as long as tarsal claws; femora slender, spines weak; tibiae straight or nearly so; basitarsi slender, about equal to next four tarsal subsegments. *Wings:* Iridescent; third costal section about one third the length of the fourth; fifth section about one and one half times as long as third and fourth combined; crossvein r-m situated before end of subcostal vein and at basal one sixth of discal cell; last section of fourth vein sinuate;

last section of fifth vein shorter than posterior crossvein; cubital cell with a very short petiole (fig. 78b). *Abdomen:* Polished black, strongly clavate from lateral view (fig. 78c); from dorsal view the sides are almost straight, being but slightly wider at fifth abdominal segment. *Hypopygium:* About three fourths the length of the fifth segment, very slightly compressed to the right and with no apparent depressed area from dorsal view (fig. 78f); the membranous area is very small and seen only in end view. From ventral view a very small membranous portion is visible at the apex of eighth segment. The ninth segment is about as broad as long, with a gibbose swelling on upper outside margin; cleft on hind margin narrowly "U" shaped. Harpagones very irregular, inner one with three strong blunt teeth on outer apical edge; outer clasper broad at base and tapering into a slender fingerlike point (fig. 78d). The sixth tergum is strongly developed (fig. 78g) and gives support to the genital chamber.

Length: body, 3.4-3.6 mm.; wing, 3.6-3.8 mm.

Female: This sex differs in having the eyes more widely separated on the front. The inner margins of the eyes are parallel, the front being as wide as ocellar triangle for its entire length. Bases of hind femora narrowly yellowish. The abdomen is noticeably enlarged posteriorly but not so clavate as in male from lateral view. Ovipositor yellow to yellowish-brown, piercer about equal to its base and distinctly swollen just before the point of articulation, reaching just beyond posterior margin of third abdominal segment; base somewhat elongate from lateral view (fig. 78h), strongly flattened dorsoventrally (fig. 78e). Otherwise like the male.

This species was taken in sedge and swamp grass meadows around the south end of Lake Tahoe. Leafhoppers of the *Thamnotettix* group were present in almost a pure culture and may serve as the host of this Dorilaidae.

Holotype ♂: Lake Tahoe, California, August 2, 1940 (R. H. Beamer). Allotype ♀ same data. Sixty-eight paratypes, fifty-one ♂ ♂, seventeen ♀ ♀, same locality and date (R. H. Beamer, D. E. Hardy, E. E. Kenaga). All deposited in Snow Entomological Collection.

Dorylomorpha uncinata n. sp.

(Plates 13, 14, figs. 79a-g)

This species is related to *exilis* (Malloch) but the specimens are of larger size; the eyes of the male are narrowly separated on the front; the abdomen is more strongly swollen, the hypopygium is

shorter in proportion to the length of the fifth segment from dorsal view; the membranous area at apex is more elongate and extends almost to anterior margin of eighth segment, the outward projecting apices of the harpagones are narrowly produced dorsoventrally. Apical halves of femora and all of tibiae yellow. Species almost entirely bare, not so densely haired. This species is separable from *caudelli* (Mall.) by the difference in the male hypopygia, membranous area at apex very distinct and no lateral depression, harpagones strongly developed outwardly at apices, shorter ovipositor and more blackened femora and trochanters of the female.

Male. Sparsely haired species. *Head:* Eyes narrowly separated on the front, front shining black on upper two thirds, slightly elevated in the middle portion; bristles of second segment short; third segment long acuminate (fig. 79f), brown to black, tip somewhat yellowish. *Thorax* (and abdomen): Polished black in ground color. thorax dusted with brownish pollen on the dorsum and somewhat grayish on sides. Humeri black, halteres yellow. *Legs:* Coxae chiefly black, apices yellowish; trochanters with a distinct yellowish tinge; femora black except for broad yellow apices; tibiae and tarsi yellow, last subsegments of tarsi faintly brown; femoral spines present on apical halves of middle femora, below; apparently absent on other legs. *Wings:* Iridescent; third costal section of wing one third to one fourth the length of the fourth section; fifth section about equal to fourth; crossvein r-m situated just beyond end of subcostal vein and at about basal one fifth of discal cell; ultimate section of fourth vein slightly curved, last section of fifth much shorter than length of posterior crossvein (fig. 79c). Abdomen typical of the genus. *Hypopygium:* Less than one half the length of the fifth abdominal segment, with a distinct membranous depression extending vertically across the entire tip of eighth segment on right side; this area runs almost to base of eighth segment from dorsal view (fig. 79e). From ventral view the membranous apex of eighth segment is very distinct, covering quite a large area; sclerotized portion of eighth much shorter than ninth segment. Ninth very broad, as wide as long; cleft on hind margin broadly "U" shaped. Harpagones irregular, sides rather straight on basal halves, outside margins strongly curved inward on apical halves; the apices are produced bootshaped on outer edges (fig. 79g).

Length: body, 4-4.6 mm.; wing, 4.3-4.7 mm.

Female. The eyes are widely separated on the front; the frontal stripe is convex in the middle, silvery on lower half, shining black on

upper portion, with a row of pale marginal hairs down each side; occiput very broad on the upper portion, being about four times as wide as the front; antennae brownish in ground color, densely white pubescent and with a long acuminate white point below (fig. 79a). Broad apices of femora, entire tibiae and first four tarsal subsegments bright yellow, legs otherwise black; femora moderately thickened, without noticeable flexor bristles; posterior tibiae swollen apically; posterior basitarsi about equal to the next four tarsal subsegments in length. The ultimate section of the fourth vein (M_{1+2}) is much more sharply curved upward for the first half of its course to the wing apex and the apical cell is more widely open in the margin (fig. 79b). The base of the ovipositor is rather elongate and slightly tuberculate beneath; the piercer is about equal to its base, abruptly tapering and distinctly articulated with its base; tip of piercer extending just beyond apex of segment four (fig. 79d).

Holotype ♂, Fallon, Nevada, Aug. 12, 1940 (D. E. Hardy); allotype ♀ same locality and date (R. H. Beamer). Six paratypes, four ♂ ♂, two ♀ ♀ from following localities: Same as type (E. E. Kenaga); Pingree Park, Colo., Aug. 14, 1934, 9200 ft. (C. W. Sabrosky); Austin, Nevada, Aug. 12, 1940 (R. H. Beamer); Ely, Nevada, Aug. 13, 1940 (D. E. Hardy) and Twin Falls, Idaho, Sept. 11-28, 1927-'31 (C. F. Henderson, V. E. Romney).

Holotype, allotype and a series of paratypes in Snow Entomological Collection. One paratype returned to the United States National Museum and one returned to C. W. Sabrosky, Michigan State College.

Tömösváryella Aczel

Tömösváryella Aczel, 1939, Zoöl. Anzeiger, Band 125, Heft ½, 22-23.

This genus, as defined in this paper, is comprised of those species, formerly of the genus *Dorilas* (*Pipunculus*) which have no stigma in the wing and in which the radio-medial crossvein is situated near the middle of the discal cell. The eyes of the males are contiguous on the front for at least a short distance and the abdomen is not greatly enlarged posteriorly in either sex. The present interpretation of this genus does not include the entire *Tömösváryella* as proposed by Aczel as the subgenus *Dorylomorpha* has been raised to generic rank.

The *Tömösváryella* are perhaps the most highly specialized and most abundant of the DORILAIDAE. They may be taken in great numbers in most any grassy environment. Most all species show a great deal of resemblance and many cannot be separated except by

use of the male genitalia; these structures usually present the best specific characters.

The hind margins of the eyes are very slightly indented toward the upper portions, so that this part of the occiput is more broadened. The third segment of the antenna is acuminate and rather consistent in shape, usually dark in ground color and covered with fine pale pubescence. The bristles of the second antennal segment are shorter, less pronounced than in most other DORILAIDAE. The humeri and halteres are consistently yellow and the propleurae bare, without a brush of strong hairs. The dorsum of the thorax has at least sparsely distributed marginal hairs and the dorsocentral hairs are usually distinct. The legs of this group are distinctive and possess some of the best diagnostic characters. The front femora of most species each have a pair of rather strong flexor bristles near their bases; the middle coxae possess several fine to very strong apical hairs or bristles. The trochanters of the hind legs of the males are the most distinctive in appearance, the under sides usually being armed with clumps of hairs, bristles, mounds, ridges or strong toothlike developments according to the species. *T. contorta* (Hardy) is the most unusual member of the genus in that the posterior femora and tibiae of the males are strongly malformed. This contortion is also seen in the females but to a much lesser extent. The tarsi of a good share of the species are flattened and somewhat dilated. This is especially true of the female. The wing venation is rather uniform and offers little in the way of specific characters. The third section of the costa is shorter than the fourth, usually one half or less its length and rarely almost equal to the fourth; fifth section of costa longer than the third and fourth combined. Crossvein r-m at or beyond the end of vein R_{1+2} and rather close to the middle of the discal cell. Ultimate section of fourth vein (M_{1+2}) straight or but faintly curved. The wings are rather short compared to members of other genera, seldom being longer than the body. The sides of the abdomen vary from straight to decidedly rounded, the abdomen usually being widest at about segment three. The pregenital segments (one to five) of the abdomen are normal in position and shape; the sixth segment has been greatly reduced and twisted under, being represented only by a narrow strip extending across the venter, often curving ventrad and giving support to the genital chamber; the seventh segment is likewise reduced to a single sclerite and twisted to the left; it is several times wider than the sixth and occupies the left side of the venter,

its inner margin fitting against the genital chamber. A small portion of the seventh sclerite is usually visible from dorsal view as a small triangular piece on the left side at the base of the eighth segment. The eighth segment forms the greater portion of the visible genitalia; this makes up the broad rounded apical portion of the abdomen. The segment has been completely twisted over via the left side so that the margins come together to form a grooved area longitudinally down the dorsum. The exact position of this junction will vary according to the amount of the twisting which has taken place in the evolution of the species. The membranous portion of the apex usually lies in about the middle of the apical margin and extends more deeply into the segment of the underside than on the dorsum.

Genotype: *Tömösváryella sylvatica* (Meigen) (*Pipunculus*).

The members of this genus are the most difficult to identify of all the DORILAIDAE and it is necessary to dissect off the terminal portion of the abdomen and study the male genital structures in order to place a good many of the species. Identification of female specimens, for the most part, is very questionable unless accompanied by the male; even then the determination is not always certain because several species of *Tömösváryella* often occur in one environment. It is possible, however, to place them in their related groups and perhaps after the extent of variations have been more thoroughly investigated characters may be used which will place them more correctly.

When making determinations of collections of *Tömösváryella* it is usually necessary to dissect a male of each series in the various groups throughout the genus. These groups are distinguished by external characters, shape of eighth segment, legs, etc.; then the species can be readily separated by the characters of the genitalia proper, the ninth segment, harpagones and cerci as well as the ventral aspects of the seventh and eighth sclerites. The posterior portion of the abdomen may be clipped off with fine dissecting scissors and relaxed in caustic potash, or the genital segments may be removed by carefully picking away the sclerites with a minute needle at about the third to fourth segments depending on the length of the harpagones on the venter. The part may be placed in hot caustic for a few minutes or soaked in cold for an hour or so, then it may be transferred directly to a drop of glycerin for study.

The species *politus* (Williston) referred to the subvirescens group by Cresson [30] belongs in *Tömösváryella* but cannot be accurately

30. 1911, Trans. Phil. Acad. Sci. 36, 314.

placed as the description is inadequate. The species was described from St. Vincent, West Indies so will not apply to this paper.

KEY TO SPECIES BASED UPON MALES

1. Posterior femora and tibiae strongly contorted (fig. 87c)); hypopygium small and densely haired (fig. 87d)..... *contorta* (Hardy), p. 157
Legs normal; hypopygium not as above..... 2

2. (1) Hypopygium symmetrical, subhemispherical in shape, not compressed to the left, with the longitudinal suture on the right side (fig. 101b); posterior trochanters each with a conspicuous square topped ridge below, this is densely covered with fine white pubescence (fig. 101a)..... *subvirescens* (Loew), p. 178
Hypopygium asymmetrical, compressed to the left, if slightly rounding, the longitudinal suture is well to the left side; hind trochanters without such developments 3

3. (2) Densely gray pollinose species; hypopygium short, somewhat rounding, but little over half the length of the fifth abdominal segment; ninth segment broad, apices developed into acute points; harpagones curved and irregular (fig. 100g)..... *subnitens* (Cresson), p. 177
Not with the above combination of characters..... 4

4. (3) Hind trochanters tuberculate below, with moundlike developments of teeth-like processes..... 5
Hind trochanters unarmed except for short hairs or bristles..... 25

5. (4) Hind trochanters each with two teeth or processes beneath (fig. 84c)..... *bidens* (Cresson), p. 153
Hind trochanters with only one tooth or tubercle beneath..... 6

6. (5) Posterior femora each with a strong basal tooth beneath; hind tarsi distinctly dilated ..... *appendipes* (Cresson), p. 150
Posterior femora never with more than a small bump near bases..... 7

7. (6) Hypopygium elongate, almost twice as long as wide, tapering to a blunt point from dorsal view..... 8
Hypopygium seldom longer than wide..... 11

8. (7) Apex of eighth segment folded downward (as seen from lateral view); venter of eighth segment with a large membranous depressed area (fig. 86c), apex largely membranous; posterior trochanters with a moundlike tubercle (fig. 86b) ..... *columbiana* (Kertesz), p. 156
Not as above; eighth segment straight, sclerotized on venter and only the extreme apex membranous; processes of hind trochanters strongly developed 9

9. (8) Hind trochanters each with a large abruptly curved tooth below (fig. 103b) ..... *toxodentis* (Hardy-Knowlton), p. 181
Hind trochanters with large rather square topped developments..... 10

10. (9) Trochanteral process oblique, shining black, slightly pointed on inner edge ..... *quadradentis* n. sp., p. 172
Trochanteral process longitudinal, yellowish in color and square topped..... *sonorensis* (Cole), p. 176

11. (7) Hind trochanters with only moundlike developments, never with elongate or sharply pointed processes..... 12
Processes of hind trochanters acutely pointed or long and slender, never just simple tubercles..... 20

12. (11) Inner harpagone greatly enlarged at apex, both harpagones strongly curved on outer margins 13
Harpagones not greatly enlarged apically, outer edges strongly curved only in *propinqua* 14

13. (12) Hind trochanters with only slightly raised portions below; ninth segment much longer than wide; cleft of ninth extending only about half the length of the segment on a middle line; inner harpagone strongly produced inwardly at apex (fig. 92a)..... *longipes* n. sp., p. 147

Hind trochanters with distinct blunt pointed projections; hypopygium short and rounding; ninth segment wider than long, cleft deeply, the cleft extending to about basal one fourth on middle line; inner harpagone strongly produced on its outer edge (fig. 82a).....*armata* Hardy, p. 152

14. (12) Dorsum of thorax and abdomen densely pale haired; scutellum especially pilose .....*brevijuncta* n. sp., p. 155
Species with only sparse scattered pile; scutellum bare or nearly so..... 15

15. (14) Cleft of ninth segment very shallow, broadly 'V' shaped; harpagones rounding apically (fig. 109a).....*xerophila* n. sp., p. 188
Ninth segment moderately to deeply cleft on posterior margin; harpagones usually acutely pointed at least on inner apices; harpagones obtuse apically only in *pauca,* which has cleft of ninth tergum extending over two-thirds its length 16

16. (15) Cerci very large, covering the larger part of the harpagone bases; sclerotized portion of eighth segment extending to apex; harpagones divergent toward apices (fig. 105c) .....*turgida* Hardy, p. 183
Cerci small; sclerotized portion of eighth not extending to apex (from ventral view); harpagones not divergent..... 17

17. (16) Harpagones slender, obtusely rounding at apices (fig. 94b).....*pauca* n. sp., p. 168
Harpagones acute on inner apices, usually rather thick..... 18

18. (17) Harpagones strongly curved on outside margins, outer one bootshaped at apex; both are slender, elongate and rounding apically (fig. 95b).....
.....*propinqua* n. sp., p. 169
Harpagones rather simple, slightly excavated on inner margins, not enlarged apically but somewhat pointed on inner apices..... 19

19. (18) Harpagones without carinae, rather broad and somewhat rounded apically, with a pronounced indentation near base of each harpagone on outside; ninth segment about as long as wide (fig. 104c).....*tumida* Hardy, p. 182
Outer harpagone with a dorsal carina, more slender with no indentations at bases; ninth segment longer than wide (fig. 107e)....*vagabunda* (Knab), p. 185

20. (11) Cerci large, completely covering over the bases of harpagones; processes of hind trochanters long and sharply pointed 21
Cerci normal not obscuring bases of harpagones, if extending beyond apex of ninth segment they are slender, not greatly broadened..... 23

21. (20) Ninth segment very deeply cleft on hind margin, cleft extending almost to base of segment; harpagones large and rounding at apices (fig. 91c); processes of hind trochanters strongly curved on apical halves (fig. 91a)..
.....*floridensis* Hardy, p. 164
Ninth segment broadly 'U' shaped on hind margin; trochanteral tooth straight 22

22. (21) Middle coxae apparently with an elongate spurlike process, above, actually made up of four to five long flat bristles lying so close as to simulate a single development (fig. 108a, 108b), no distinct longitudinal groove on eighth segment .....*wilburi* (Hardy), p. 187
Middle coxae with two to three narrow, shorter bristles which are distinctly separate; overlapping of eighth segment evident on dorsum.....
.....*utahensis* (Hardy), p. 184

23. (20) Processes of posterior trochanters long and slender but bluntly tipped (fig. 90d); harpagones with an obtuse point on inner edges just below middles, more pronounced on outer harpagone (fig. 90b).....*exilidens* n. sp., p. 162
Processes differently developed; harpagones not as above..... 24

24. (23) Processes sharply pointed and slender, located near apices; outside harpagone broad and blunt, square tipped; inner clasper blunt and slightly curved inward at apex (fig. 89d).....*dissimilis* n. sp., p. 161
Trochanteral processes not so sharply pointed, more thickened; harpagones slender, slightly curved inward and somewhat pointed at apices (fig. 97e),
.....*sachtlebeni* (Aczel), p. 173

25. (4) Base of ninth segment extended to or very near the apex of eighth segment on left side, as seen from ventral view (fig. 88f); hind trochanters each with two to five strong bristles; harpagones rather broad.....
.....25a. *coquilletti* (Kertesz), p. 159
Not as above; eighth segment extending around left side; ninth usually not extending over half way to apex..... 26

25a. Third segment of antennae brown to black.....
.....*coquilletti coquilletti* (Kertesz), p. 159
Third segments of antennae yellow.....
.....*coquilletti* var. *flaviantenna* (Hardy-Knowlton), p. 160

26. (25) Harpagones long and slender (fig. 102e).....*sylvatica* (Meigen), p. 180
Harpagones not so shaped..... 27

27. (26) Harpagones produced on outside apices into a pair of sharply pointed incurving lobes (fig. 83b) .....*beameri* Hardy, p. 153
Harpagones not so developed..... 28

28. (27) Harpagones developed dorsally into strong carinae, very blunt and rounding apically, outer harpagone almost twice as thick as inner...*minacis* Hardy, p. 167
Harpagones without noticeable carinae, somewhat pointed on inner apices.... 29

29. (28) Harpagones greatly enlarged apically, especially inner one; ninth segment elongate, much longer than wide, about twice as long as the sclerotized portion of the eighth on left side, from ventral view (fig. 92c).....
.....*lepidipes* n. sp., p. 166
Harpagones not greatly enlarged at apices; ninth segment broad, about as wide as long, about equal to sclerotized portion on left side..... 30

30. (29) Crossvein r-m situated beyond the middle of discal cell; ultimate section of fourth vein sinuate; ninth segment broadly 'U' shaped on hind margin; harpagones broad, rather blunt at apices (fig. 80b); thorax, abodemn and hypopygium rather thickly haired.....*agnesea* Hardy, p. 149
Crossvein r-m situated before middle of discal cell; ultimate section of fourth vein straight; ninth segment with a 'V' shaped cleft on hind margin, about half its length; harpagones more slender; almost bare species....
..... *similis* (Hough), p. 174

Tömösváryella agnesea Hardy

(Plate 14, figs. 80a-c)

Tömösváryella agnesea Hardy, 1940, Jour. Kans. Ento. Soc., Vol. 13, No. 4, 103-106.

This species is widely scattered over western America and is readily separated by the r-m crossvein being beyond the middle of discal cell, the broad square-tipped harpagones of the male and the large development on the base of the female ovipositor below.

Following is the original description:

"*Male.* Head: Frontal triangle silvery, darker in the middle, upper portion of front shining black; third antennal segment acuminate, brown to black in ground color, densely white pubescent; mouthparts yellowish; compound eyes joined for less than one-third the length of the frontal triangle (fig. 80a). *Thorax* and *abdomen:* Metallic black in ground color but rather densely gray pollinose and more thickly haired than in *similis;* humeri and halteres bright yellow; legs colored as in *similis,* front femora with a pair of flexor bristles near bases; middle coxae with two to three long bristles at their apices; hind trochanters each with a clump of stout short hairs below, these are more numerous but not so long and thin as in *similis;* femora moderately thickened, spines very weak; tibiae almost straight; hind tarsi flat-

tened and dilated. *Wings:* Very faintly iridiscent, third section of costa about one-half the length of the fourth; fifth section almost twice as long as third and fourth combined; crossvein r-m situated about half way between the ends of vein R_{1+2} and R_{3+4} and beyond the middle of the discal cell; last section of fourth vein sinuate. Sides of abdomen almost straight, widest at second and third segments; fifth segment but little longer than the fourth. *Hypopygium:* About three-fourths the length of the fifth segment, scarcely compressed to the right, with a large apical depressed area; the longitudinal groove lies slightly to the left due to the longer overfolding of the eighth segment on the right side (lateral view, fig. 80c). From ventral view, in a relaxed condition, the hypopygium is usually quite acutely pointed due to the expansion of the membranous areas at the apex. The ninth sclerite is about as broad as long, with a broadly U-shaped concavity on the hind margin, cleft less than one fourth its length. Harpogones broad and flat, rather square tipped and but slightly hollowed out on the inner margins below (fig. 80b). Aedeagus with two large basal supporting plates attached to ninth sclerite by apodemes.

"Length: body, 3 mm.; wings, 2.7 mm.

"*Female:* The females are for the most part inseparable from *similis* unless accompanied by the males. The upper one-third of the front is shining black; the r-m crossvein is situated at or beyond the middle of the discal cell; the ultimate section of the fourth vein is slightly curved instead of straight, as in *similis* and the body is more pollinose. Posterior tarsi flattened and somewhat swollen, first tarsal subsegment almost equal to the remaining four. Base of ovipositor subglobose, shining black, piercer scarcely longer than base and extending just beyond apex of third segment."

Type locality: Lawrence, Kansas.

Type in the Snow Entomological Collection.

This species is one of the most common western Dorilaids, it is often taken in abundance, in Bermuda grass, Blue grass, Johnson grass, and other like habitats. This species has been identified from numerous localities in the following states: Arizona, California, Colorado, Idaho, Kansas, Nevada, New Mexico, Oregon, Utah and Washington.

Tömösváryella appendipes (Cresson)

(Plate 14, figs. 81a-h)

Pipunculus appendipes Cresson, 1911, Trans. Am. Ent. Soc. XXXVI; 319-320.

This species is very easily recognized by the characters on the posterior legs of the male; the single tooth of process on the trochanters accompanied by a distinct tubercle at the bases of the femora; the posterior tarsi are also strongly dilated.

Male. Chiefly subshining black, almost bare species, with only a few scattered microscopic hairs. Face silvery, front silvery with a faint tinge of yellow; eyes joined for about one half the length of

the frontal triangle; occiput gray below, subshining on upper portion; mouthparts yellowish; third segment of antennae brownish black to brownish with a distinct yellow tinge, densely white pubescent; third segment acuminate below (fig. 81a). *Thorax:* Mesonotum and scutellum only lightly dusted with brown; metanotum subshining medianly, grayed on the sides; pleurae moderately gray pollinose; humeri and halteres yellow; legs chiefly black, apices of femora and tibiae, bases of tibiae and first four tarsal subsegments yellow; femora moderately thickened, flexor bristles very weak; posterior trochanters with an elongate, blunt, slightly curved tooth-like process below near their apices in the typical form; this varies somewhat and some specimens have just an acute tubercle (figs. 81b, 81d, 81h); hind femora with a distinct tubercle on undersides near bases; posterior tibiae almost straight; hind tarsi flattened and dilated, wider than the tibiae; basitarsi about equal in length to the next four subsegments (fig. 81b). *Wings:* Third section of costa about one half the length of the fourth, fifth section about twice as long as the third and fourth combined; crossvein r-m situated just before the middle of the discal cell and beyond end of R_{1+2}; last section of fourth vein with but a slight curvature, much longer than the third section of that vein (fig. 81c). *Abdomen:* Shining, metallic black, dusted with gray only faintly on the first tergum; sides slightly rounding, widest at segments three and four; fifth segment about one third longer than the fourth. Hypopygium about three fourths the length of the fifth segment, faintly pollinose, asymmetrical, with a median cleft formed by the edges of the eighth tergum coming together on the dorsum. The harpagones are asymmetrical, the one on the inner side being much thicker and larger than the outer clasper; harpagones rather elongate, curved and pointed on inner sides at apices, inner margin somewhat hollowed out, concave (fig. 81e).

Length: Body 2.4-3.0 mm.; wings 2.2-2.8 mm.

Female. The females fit near *similis* (Hough) but can usually be separated by the entirely shining abdomen, dilated hind tarsi and differently shaped ovipositor. The front is wider than the face and depressed medianly; shining black on upper one third, silvery on lower portion. Base of ovipositor globose, piercer long and slender, extending almost to the apex of the second segment (fig. 81g). Otherwise like the male.

Length: body and wings, 2.5-3 mm.

Type locality: Summerville, South Carolina.

Type No. 5032 in Philadelphia Academy of Science.

This species is very widely distributed; specimens have been identified from the following states: California, Colorado, Florida, Illinois, Iowa, Kansas, Louisiana, Nevada, North Carolina, Ohio, Oklahoma, Tennessee, Utah, Vermont, and Virginia.

Tömösváryella armata Hardy

(Plate 14, fig. 82a-b)

Tömösváryella armata Hardy, 1940, Jour. Kans. Ent. Soc. 13, 106-107.

Following is the original description:

"This species belongs to the *vagabunda* group by having the hind trochanters of the male armed with tubercles; the shape of these developments and the male genital characters will distinguish it from all other species.

"*Male.* Rather sparsely haired species, dorsocentral hairs present and also scattered marginal hairs on mesonotum, scutellum and abdomen. *Head:* Face and frontal triangle silvery, the latter slightly darker; front shining black above junction of eyes; eyes joined for more than half the length of the frontal triangle; antennae black, third segment acuminate. *Thorax* and *abdomen* subshining black in ground color rather densely brownish pollinose; grayed on the margins, pleurae and metanotum. *Legs:* Femora moderately thickened, flexor spines weak; front femora with one or two rather weak flexor bristles near bases, middle coxae with three to four moderately strong black apical bristles; hind trochanters comparatively short in length, each with a distinct obtuse carina or tubercle just beyond the middle below (fig. 82b); this tubercle is thickly covered with microscopic white pile; hind tibiae slightly curved, tarsi flattened; basitarsi longer than the next three subsegments. *Wings:* Very lightly iridescent, third costal section about half the length of fourth section; fifth section about twice the length of third and fourth combined; crossvein r-m situated much beyond the end of vein R_1 (R_{1+2}) and at middle of discal cell; ultimate section of fourth vein about straight; last section of fifth shorter than posterior crossvein. Sides of abdomen somewhat rounding, fifth segment about one third longer than fourth. *Hypopygium:* Rather symmetrical, broadly rounding, about three fourths the length of the fifth segment, only slightly compressed to the right with a broad longitudinal groove medianly and a distinct apical depression. Ninth segment about as broad as long, with a 'V' shaped cleft apically about three fourths of its length on median line. Harpagones asymmetrical, inner clasper greatly enlarged at apex with a large rounding lobe on right side, from ventral view; outer clasper enlarged at apex but not so developed (fig. 82a).

"Length: body, 3 mm.; wings, 2.8 mm.

"*Females.* The females associated here have the upper one third of the front shining with a narrow black stripe extending down into the silvery area; the hind trochanters are unarmed except for a few pale hairs below; the tarsi are more flattened and dilated. The base of the ovipositor is globose, the piercer about twice its length and gradually tapering at base; piercer extending to apex of second abdominal segment."

Type locality: Griffin, Georgia.

Type in the Snow Entomological Collection.

Tömösváryella beameri Hardy

(Plate 14, figs. 83a-b)

Tömösváryella beameri Hardy, 1940, Journ. Kans. Ent. Soc. 13, 107.

Following is the original description:

"This species is related to *similis* (Hough) but the male genitalia are very distinctive. The specimens are also smaller in size.

"*Male.* Fitting the description of *similis* in most details. The eyes are joined for less than one third of the length of the frontal triangle and the front is silvery above the junction of the eyes. The thorax and abdomen are more distinctly pollinose and more thickly haired. The dorsocentral hairs rather strong. Posterior trochanter with just a few inconspicuous short hairs, and distinctly carinated beneath (fig. 83a). Posterior basitarsi longer than next four tarsal subsegments; hind tarsi flattened. Wings more hyaline, very slightly milky. Hypopygium like *similis* in dorsal view, from ventral view the ninth segment is much longer than wide, equaling the eighth in length, with a V-shaped cleft on apical margin, extending over one-third its length. Harpagones very irregular, almost symmetrical, with their posterior lateral margins strongly produced into a pair of sharply pointed incurving lobes (fig. 83b); inner clasper slightly longer than the outer.

"Length: body, 2.1-2.3 mm.; wings, 2.2 mm.

"*Female.* Differs from *similis* in having the piercer of the ovipositor about twice as long as base and extending beyond the apex of the second segment. The posterior basitarsi are short and very flat, scarcely as long as the next three tarsal subsegments in length."

Type locality: Douglas County, Kansas.

Type in Snow Entomological Collection.

Added distribution: Glasco, Kansas, Aug. 24, 1940 (L. C. Kuitert, L. J. Lipovsky); Downs, Kansas, Aug. 24, 1940 (R. H. Beamer); Clay Center, Kansas, Aug. 24, 1940 (R. H. Beamer, L. C. Kuitert) and Walnut, Kansas, Aug. 31, 1940 (R. H. Beamer).

Tömösváryella bidens (Cresson)

(Plate 14, figs. 84a-f)

Pipunculus bidens Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 320.

This species is easily recognized by two appendages on each posterior trochanter of the male.

Male. Small chiefly bare species, with only scattered pale hairs on thorax and abdomen. *Head:* Face silvery, frontal triangle lightly golden tinged, upper part of front and vertex shining black; occiput gray on the sides, subshining black on upper portion; eyes joined on the front for about one half the length of the frontal triangle; antennae brown to black, third segment with a faint yellowish tinge in ground color, densely white pubescent and acuminately pointed below (fig. 84a). *Thorax:* Mesonotum and scutel-

lum shining black, lightly brown dusted; metanotum and pleurae faintly gray; humeri and halteres yellow. Legs chiefly black, apices of femora and tibiae, bases of tibiae and first four tarsal subsegments yellow, last joint of tarsi brown; femora moderately thickened, flexor spines weak; front femora with two well developed flexor bristles near bases; middle coxae with two to three long bristles at apices above; hind trochanters each with a pair of elongate projections on undersides, one on the outer ventral margin just below the base and the other on the inner ventral margin just below the apex of the segment (fig. 84c); hind tarsi slightly flattened and dilated, posterior basitarsi equal to the next four subsegments in length. *Wings:* Third costal section about one third the length of fourth; fifth section over two times the length of third and fourth sections combined; crossvein r-m situated beyond the end of vein R_{1+2}, just before middle of the discal cell; last section of fourth vein slightly curved (fig. 84b). *Abdomen:* Shining metallic black, very faintly dusted; sides almost straight, slightly wider at segments two and three; fifth segment one third longer than the fourth. *Hypopygium* very similar to *appendipes,* scarcely any notable difference; the longitudinal cleft is usually slightly more to the right and a more distinct apical depression is visible (fig. 84d). The harpagones are similar to *appendipes* (Cresson), with the inner clasper more developed than the outer (fig. 84f).

Length: body, 2.8 mm.; wings, 2,3-2.5 mm.

Female. The female is very similar to *appendipes* (Cresson) and *similis* (Hough) and is difficult to separate without association of the male. The frontal stripe is very broad, widest in central portion and sunken in medianly. The front is almost entirely cinereous with only a small shining black portion above near vertex. Posterior trochanters armed with several strong hairs beneath. Base of ovipositor subglobose, piercer slender, reaching to about the apex of second segment in normal position (84e).

Length: body 2.8 mm.; wings, 2.3-2.5 mm.

Type locality: Yosemite Valley, California.

Type No. 5031 in Philadelphia Academy of Science.

The writer has examined the type series and has a series of homotypes and a large series of topotypes, Aug. 1, 1940 (R. H. Beamer, L. C. Kuitert, D. E. Hardy). The species is widely distributed, having been collected in México and from numerous localities in the following states: California, Florida, Kansas, New Mexico, and Oklahoma.

Tömösváryella brevijuncta n. sp.

(Plate 15, figs. 85a-f)

This species is related to *agnesea* Hardy and to *vagabunda* (Knab); it differs from both of these in being densely pale haired on the dorsum of the thorax and abdomen, scutellum especially hairy; the strong development on the hind trochanters, much more pronounced than in *vagabunda*. It is of much larger size than *vagabunda*, the r-m crossvein is situated beyond the middle of the discal cell; the eighth segment does not overlap past the median portion from dorsal view and the longitudinal membranous area is wide and distinct. The harpagones are not carinated and are more strongly curved on outer margins; these are more slender and curved than in *agnesea* and the cleft of ninth segment is deeply 'V' shaped. The females fit near *agnesea* by the position of the r-m crossvein; they are best separated by the hairiness of the dorsum and the shape of the ovipositor base.

Male. Head: Eyes joined for only a short distance on the upper portion of the front; junction about equal to the length of ocellar triangle, portion of front above junction shining black, lower part silvery pubescent; bristles of second antennal segment weak, third segment brownish with slight tinge of yellow; subacuminate below; first two subsegments of arista yellowish. *Thorax:* Margins and most of posterior portion of mesonotum thickly covered with long yellow hairs; dorsocentral hairs strong; scutellum and humeri very densely haired; humeri and halteres yellow; metanotum with a distinct transverse grooved area. *Legs:* Chiefly black, extreme apices of femora and tibiae, bases of tibiae and first four subsegments of tarsi yellow; ultimate tarsal subsegments brownish; front femora with no apparent flexor bristles at bases; apical hairs of middle coxae moderately slender and yellow; process of hind trochanter large and rounding, densely covered with pale pile; produced as long as the width of the trochanter at base (fig. 85e); hind tibiae slightly arcuate; basitarsi about equal to next three tarsal subsegments in length. *Wings:* Lightly iridescent, third section of costa about one half the length of the fourth; fifth section almost twice as long as third and fourth combined. Crossvein r-m situated just beyond middle of discal cell and well beyond end of first vein (R_{1+2}); last section of fourth vein slightly curved; last section of fifth shorter than length of posterior crossvein and becoming faint near the wing margin. Sides of abdomen almost straight, slightly widest at segments two to three. Fifth abdominal segment

almost twice as long as fourth. *Hypopygium:* About three fourths the length of the fifth segment. Longitudinal membranous area median in position, broad and very distinct; seventh sclerite scarcely visible from dorsal view (fig. 85c). From ventral view the membranous area is very extensive, covering the entire apex; sclerotized portion of eighth on left side much shorter than ninth segment. Ninth segment slightly longer than broad, cleft on hind margin deeply 'V' shaped extending half the length of the segment. Harpagones strongly curved, inner margins concave. Cerci slender, not greatly enlarged, extending just beyond apex of ninth segment (fig. 85d).

Length: body, 3.6-3.8 mm.; wing, 3.4 mm.

Female. Front broad, slightly concave longitudinally, silvery gray pollinose to the ocellar triangle. Front femora with a pair of small, black, flexor spines near bases below. Posterior trochanters somewhat swollen below, with a clump of fine yellow hairs (fig. 85f), no projection as in male. Base of ovipositor subglobose, piercer slender, about twice as long as base (fig. 85b) and extending beyond posterior margin of second abdominal segment. Otherwise like the male.

Holotype ♂: Palm City, California, July 19, 1940 (R. H. Beamer); allotype ♀, same locality and date (D. E. Hardy). Sixteen paratypes, nine ♂♂, seven ♀♀, same locality and date (R. H. Beamer, D. E. Hardy, E. E. Kenaga). All are in the Snow Entomological Collection.

The type series was taken sweeping in a large salt grass and clump grass meadow. Leafhoppers of the genus *Parabolocratus* were by far the most abundant and possibly serve as host for this species.

Tömösváryella columbiana (Kertesz)

(Plate 15, figs. 86a-d)

Pipunculus columbianus Kertesz, 1915, Ann. Mus. Nat. Hungar. 13, 386.
Pipunculus trochanteratus Malloch, 1913, Proc. U. S. Nat. Mus. 43, 297-298.

Tömösváryella columbiana (Kertesz) is a change of name as *trochanteratus* was first used by Becker to designate an Egyptian species, 1900, Ent. Zeitschr. XIV; 221.

Examination of the type of *trochanteratus* Malloch (nec Becker) proved it to be very different from that species which has previously been placed here. It is distinctive from all other species in the complex by the unusual development of the male hypopygium and the shape of the trochanteral tubercle.

Male. Face and frontal triangle silvery, front above junction of

eyes shining; eyes joined for less than one half the length of the frontal triangle; antennae yellow-brown to blackish in ground color, third antennal segment long acuminate (fig. 86a); vertex and upper occiput shining to subshining, lower occiput gray pruinose. *Thorax:* Mesonotum subshining, covered with brownish pollen, pleurae and metanotum silvery to gray, humeri and halteres yellow. *Legs:* Chiefly brown to black, apices of femora and tibiae, bases of tibiae and first four tarsal subsegments, yellow. Hind legs somewhat contorted, femora rather strongly swollen, tibiae swollen medianly and arcuate; posterior trochanters each with a large blunt, almost square tipped process beneath (fig. 86b). *Wings:* Lightly iridescent; third costal section one third to one half the length of the fourth; crossvein r-m situated at about middle of discal cell and beyond end of vein R_{1+2}; ultimate section of fourth slightly curved, last section of fifth much shorter than posterior crossvein; cubital cell with a rather long petiole. *Abdomen:* Subshining, only lightly dusted, sides faintly cinereous, more so on fifth tergum; sides of abdomen almost straight. *Hypopygium:* Very distinctive, lightly gray dusted, produced apically into an elongate bluntly pointed process which folds downward just beyond middle; it is possible that this folds up into the depressed area on the venter of the hypopygium in normal position; this folding is toward the left side (fig. 86c). The long terminal portion is thickly covered with fine yellow pile and is largely membranous; a longitudinal ridge runs down the middle of the hypopygium above (fig. 86d).

Length: 2.5 mm.

Female unknown.

Type locality: Kaslo, British Columbia.

The above description is based upon the type in the United States National Museum.

Tömösváryella contorta (Hardy)

(Plate 15, figs. 87a-g)

Pipunculus contortus Hardy, 1939, Jour. Kans. Ent. Soc. V. 12, No. 1, pp. 18-19.

This is distinctive from all other known species in the family by the abnormally malformed posterior legs of the male and the peculiarly developed hypopygium.

The following is the description of the male altered slightly from the original:

Male. Head: Face silvery pubescent, front golden, subshining black in ground color. Eyes contiguous for only a short distance on the upper part of the front, joined for only a fraction of the length

of the front. Sides of occiput silvery pollinose, upper portion and vertex subshining black. Third antennal segment short acuminate (fig. 87a), brownish in ground color. "Thorax and abdomen: Lightly gray pollinose, but slightly shining and covered with very fine, short brownish pubescence. Pleurae, metanotum and sides of abdomen more conspicuously grayed. Humeri and halteres bright yellow. *Legs:* Chiefly black except for extreme apices of femora and tibiae, broad bases of tibiae and first two tarsal segments which are yellow; other tarsal segments brown to black. Femoral spines very weak." Posterior femora and tibiae strongly contorted, posttrochanter with a well developed tubercle beneath (fig. 87c), tarsal subsegments of hind legs flattened. "Wings: Hyaline, without stigma. Third costal section short, about one third to one fourth the length of the fourth section. Cross-vein r-m situated at the middle of the discal cell, just beyond the middle of the fourth costal section. Last section of fourth vein slightly sinuate; ultimate section of fifth vein equal in length to the posterior crossvein. Petiole of cubital cell long." Sides of abdomen somewhat rounding, broadest at segments two and three; segment five about one and one third times as long as four. *Hypopygium:* Rather small and rounding, about one third as long as fifth segment, densely brown to black haired, eighth segment especially hairy on left side (fig. 87f). Hypopygium scarcely compressed to the right and with a median depression formed by the coming together of the margins of the eighth tergum (fig. 87d). Ninth segment yellow-brown, with a 'V' shaped cleft extending about half its length on a middle line. Harpagones slender, slightly enlarged and hooked inward at their apices; almost symmetrical, inner clasper slightly longer than outer (fig. 87g).

Length: body, 3-3.5 mm.; wings, 3.5-4 mm.

Female. The females are separable from other *Tömösváryella* by the thickened hind femora, arcuate and thickened tibiae (fig. 87b). Front silvery on lower two thirds, shining black on upper one third, below ocelli; front concave longitudinally, strongly indented between the eyes. Base of ovipositor somewhat rounding, piercer slender, slightly longer than its base and reaching to posterior margin of the third abdominal segment (fig. 87e). Otherwise like the male.

Type locality: Douglas County, Kansas.

Type at Kansas State College.

This species is widely distributed, although is more common in the middle west. The writer has a large series of topotypes (R. H.

Beamer, D. E. Hardy) also specimens from numerous localities in the following states: California, Colorado, Georgia, Kansas, Minnesota, and Nevada; also Manitoba.

Tömösváryella coquilletti (Kertesz)

(Plate 15, figs. 88a-g)

Pipunculus coquilletti Kertesz, 1907, Ann. Musei Nationalis Hungarici, v. 582.
Pipunculus proximus Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 318-319. .

This species has been unrecognizable from the original description, from which it would seem to be unique from all other *Tömösváryella* in having the hypopygium compressed to the left. This is not actually the case. Examination of the type in the Hungarian National Museum and comparison with homotypic specimens of *proximus* proved them to be conspecific.

Tömösváryella coquilletti is one of the most easily distinguished of the similis group. It can be recognized by strong bristles on the posterior trochanters and the distinctive hypopygium of the male. It is apparently one of the most common American species in this complex.

Male. Face and frontal triangle silvery, front above junction of eyes shining black, as is the vertex; eyes joined for less than half the length of the frontal triangle; third segment of antennae brownish to black, rather slender and long, white, acuminate below (fig. 88a), bristles of second segment very weak. *Thorax* and *abdomen:* Shining black in ground color, very faintly brownish to gray dusted; metanotum, parts of pleurae and first abdominal tergum lightly cinereous, sternopleurae entirely shining; humeri and halteres yellow; dorsocentral and marginal hairs distinct on mesonotum, body otherwise sparsely haired. *Legs:* Chiefly black, apices of femora and tibiae, bases of tibiae and first four tarsal subsegments yellow, last subsegment brown, front femora with a pair of rather strong flexor bristles near bases; mid-coxae with patches of strong, downward projecting bristles on their apices; posterior trochanters each with two to several strong bristles on undersides (fig. 88d); femora moderately thickened, bristles rather well developed beneath on apical one third; posterior tibiae slightly curved; basitarsi about equal in length to next three tarsal subsegments. *Wings:* Faintly iridescent, the third section of costa about one third the length of the fourth, fifth section about twice as long as third and fourth combined; fork of Rs situated before the arculus; crossvein r-m located about half way between the ends of veins R_{1+2} and R_{3+4} and just before the middle of the discal cell; ultimate section of fourth

vein slightly curved (fig. 88b). *Abdomen:* With a faint metallic luster, sides slightly rounded, widest at segment three; fifth segment scarcely one third longer than the fourth. *Hypopygium:* About three fourths the length of the fifth segment, compressed to the right, asymmetrical, with an apical depressed area and a longitudinal groove on the right side as viewed from above (fig. 88g). Hypopygium very often extended so that the ninth segment is plainly visible on the right side and the seventh tergum on the left side, from dorsal view. From ventral view the hypopygium is very characteristic, the ninth segment is elongate, longer than the eighth in length, its anterior margin almost reaching to the membranous area at the apex of the eighth; ninth segment with a deep 'V' shaped cleft on posterior margin and a distinct longitudinal groove down the middle. Harpagones simple, gently curved on inner margins and bluntly pointed (fig. 88f).

Length: body and wings 3-3.5 mm.

Female. Front chiefly silvery, shining on the upper one third, subshining in the middle; post-trochanter with four to five strong bristles beneath. Ovipositor rather slender, reaching beyond apex of the second abdominal segment; base subglobose, piercer longer than base (fig. 88e); otherwise like the male.

Type locality: Adirondack Mountains, New York.

Type in Hungarian National Museum.

This species is very widely distributed. The writer has studied the type of *proximus* at the Philadelphia Academy of Science and has identified specimens from the following states and provinces: British Columbia, California, Colorado, Connecticut, Florida, Idaho, Illinois, Iowa, Kansas, Maine, Massachusetts, Michigan, Minnesota, Nebraska, Nevada, North Carolina, New Hampshire, New Jersey, New York, Nova Scotia, Oklahoma, Pennsylvania, Quebec, Rhode Island, South Carolina, South Dakota, Texas, Utah, Vermont, Virginia, Washington and Wisconsin; also Alaska.

Tömösváryella coquilletti var. *flaviantenna* (Hardy-Knowlton).

Pipunculus proximus var. *flaviantennus* Hardy-Knowlton, 1939, Ann. Ento. Soc. Amer. XXXII; 118.

This might better be considered a western subspecies; it differs from the typical form in having the third antennal segment yellow, the ovipositor of the female more slender, reaching almost to base of the abdomen and the abdomen of the male narrower; sides almost straight, not so rounding as in *coquilletti coquilletti* (Kertesz).

Type locality: Smithfield, Utah.

Type is at the United States National Museum.

This subspecies has been recorded from Idaho, Utah and Washington.

Tömösváryella dissimilis n. sp.

(Plates 15 and 16, figs. 89a-e)

This species belongs in the sachtlebeni-utahensis group by possessing an acute development on hind trochanter, and it is distinguished from all other known species by the broad, bluntly tipped harpagones and small cerci.

Male. Small almost entirely bare species. *Head:* Eyes joined for about one third the length of the front; frontal triangle silvery; bristles of second antennal segment weak; third segment rather long, acuminate (fig. 89e) dark brown in ground color, tip and clothing pubescence yellowish; basal two sections of arista with a faint yellowish tinge. *Thorax:* Polished black in ground color, pleurae and metanotum gray, mesonotum and scutellum lightly dusted with brown, grayish pollinose on the sides; humeri and halteres yellow. *Legs:* Chiefly black, extreme apices of femora and tibiae, bases of tibiae and first four tarsal subsegments yellow; femoral spines distinct but weak; front femora each with a pair of weak pale flexor bristles near bases below; middle coxae with moderately strong apical bristles above; process of the hind trochanter acutely pointed, situated near apex of segment (fig. 89a); posterior basitarsi slightly dilated, a little longer than the next three tarsal subsegments. *Wings:* Rather typical, third costal section about half as long as fourth; fifth section one and one half as long as third and fourth combined; crossvein r-m situated just beyond end of vein R_{1+2} and before middle of discal cell; ultimate section of fourth vein slightly sinuate. *Abdomen:* Polished black, only faintly dusted; sides slightly rounding, widest at segments three to four; fifth abdominal segment about one third longer than fourth. *Hypopygium:* Almost equal to the fifth segment in length; seventh segment scarcely visible from dorsal view. Eighth segment with a median longitudinal depressed area formed by the extensive membranous portion (fig. 89e). From ventral view the large membranous apex extends over half the distance from the apex to the base of the ninth segment. Ninth slightly longer than wide and longer than sclerotized portion of eighth segment on left side. Apical cleft broadly 'V' shaped, extending more than half the length of segment on middle line. Harpagones broad and blunt, outer harpagone being the thicker and shorter of the two (fig. 89d). Cerci

narrow, extending beyond apex of ninth segment but not greatly developed.

Length: body, 2.5-2.7 mm.; wings, 2.5 mm.

Female. The females associated here have the front entirely silvery; flexor bristles of front femora strong; hind trochanters unarmed except for a few scattered pale hairs. Base of ovipositor shining black, almost globose in shape; piercer but little longer than base, thickened and gradually tapering from base (fig. 89b), extending beyond posterior margin of third abdominal segment. Otherwise like the male.

Holotype ♂ ; Sunnyside Canyon, Huachuca Mountains, Arizona, July 9, 1940 (R. H. Beamer); allotype ♀ same data. Twenty-three paratypes; nine ♂ ♂ , four ♀ ♀ , same locality and date as type (R. H. Beamer, D. E. Hardy); three ♂ ♂ Chiricahua Mountains, Arizona, July 4, 1940 (R. H. Beamer, D. E. Hardy); five ♂ ♂ , Arivaca, Arizona, July 12, 1940 (R. H. Beamer, D. E. Hardy) and two ♂ ♂ , Mountain Park, New Mexico, July 4, 1940 (R. H. Beamer). All are in the Snow Entomological Collection.

Tömösváryella exilidens n. sp.

(Plate 16, figs. 90a-d)

This species is related to *utahensis* (Hardy-Knowlton) but is easily separated by the long slender, bluntly tipped trochanteral process, the small cerci and the developments on the inner margins of harpagones. The membranous apex of the eighth segment is greatly expanded and the cleft of ninth extends more than half the length of segment on a middle line.

Male. Small chiefly bare species. *Head:* Eyes joined for only a short distance on the front, the junction scarcely longer than the length of ocellar triangle; frontal triangle with a faint longitudinal groove running its length down the middle; front and face silvery pubescent; antennae black, bristles of second segment weak, third segment acuminate, fitting figure of *dissimilis* (fig. 89c). *Thorax:* Subshining in ground color, rather thickly dusted with brown on dorsum, grayed on the pleurae and sides of mesonotum; metanotum with a faint transverse groove near upper margin, cinereous above and subshining on lower portion; humeri and halteres yellow; anterior lateral margins of mesonotum with a row of strong yellow hairs, dorsocentral hairs present but rather weak. *Legs:* Typical in coloration except for a brownish tinge to all the tarsal subsegments; front femora each with a pair of rather strong yellow bristles near bases below; mid-coaxae with moderately strong dark bristles

at their apices; process of hind trochanter long, slender, slightly enlarged and blunt at apex (fig. 90d); this development is about equal to the width of the trochanter and situated just beyond the middle of the segment below. *Wings:* Third costal section about one third the length of the fourth, fifth section twice as long as third and fourth combined; crossvein r-m situated before the middle of discal cell and just beyond apex of vein R_{1+2}; ultimate section of fourth vein very slightly curved; last section of fifth a little shorter than length of posterior crossvein; petiole of cubital cell elongate. *Abdomen:* Metallic black in ground color, lightly dusted with gray; sides rounding, widest at segments three to four. *Hypopygium:* Almost as long as fifth abdominal segment, the membranous portions being quite distended at apex and extending basally just to the left of a median line (fig. 90a). From ventral view the greatly extruded membranous apex is more plainly visible. The ninth segment is about as wide as long and is scarcely longer than the sclerotized portion of the eighth segment on left side. The cleft of ninth segment is 'V' shaped and rather deep. Harpagones quite broad, with outer margins nearly straight; the inner margins are rather strongly curved on apical portions, produced into blunt lobes just below middles; apices blunt but slightly pointed on inner margins. Cerci small and slender, scarcely extending past posterior margin of ninth segment (fig. 90b).

Length: body 2.2-2.5 mm; wings, 2.3 mm.

Female. The female specimens that have been associated have a yellowish tinge to the third antennal segment; front entirely silvery, very broad, much wider in the middle than at antennae and somewhat concave. Bristles of front femora and middle coxae much stronger than in the male; hind trochanters slightly swollen beneath but armed only with a few pale hairs. Hind femora with several rows of strong yellow hairs. Base of ovipositor shining black, subglobose; piercer slender, longer than its base (fig. 90c) and extending about to anterior margin of third abdominal segment. Otherwise like the male.

Holotype ♂, Sunnyside Canyon, Huachuca Mountains, Arizona, July 9, 1940 (D. E. Hardy); allotype ♀, same data as type. Twenty-eight paratypes; three ♂♂, one ♀, same locality and date as type (R. H. Beamer, D. E. Hardy); four ♂♂, Yosemite National Park, California, Aug. 1, 1940 (R. H. Beamer, D. E. Hardy); one ♂, Lake Tahoe, California, August 11, 1940 (R. H. Beamer); eleven ♂♂, two ♀♀, Moriarty, New Mexico, June 24, 1940 (R. H. Beamer, E. E. Kenaga, L. J. Lipovsky, D. E.

Hardy); three ♂ ♂, one ♀, Estancia, New Mexico, June 24, 1940 (D. E. Hardy); one ♂, Cloudcroft, New Mexico, June 27, 1940 (R. H. Beamer) and one ♂, Mountain Park, New Mexico, June 27, 1940 (D. E. Hardy). All are in the Snow Entomological Collection.

Tömösváryella floridensis Hardy

(Plate 16, figs. 91a-c)

Tömösváryella floridensis Hardy, 1940, Journ. Kans. Ent. Soc. 13, 109-110.

Following is the original description:

"This species is related to *toxodentis* (Hardy-Knowlton), the two are readily separated by comparing the toothlike developments of the posterior trochanters and the male hypopygia.

"*Male.* Almost entirely black, sparsely pilose species. *Head:* Antennae yellow-brown to brown, third segment long acuminate, first two sections of the arista pale; eyes joined on upper portions of front for about one-half the length of the frontal triangle; face silvery pubescent; front, below the junction of the compound eyes, faintly gray to silvery; upper portion of front and vertex shining black; occiput subshining, only faintly gray dusted above, cinereous on the sides and lower portion; posterior margin of eyes slightly indented on upper half so that the portion of the occiput above is more swollen. *Thorax* and *abdomen:* Shining metallic black in ground color, very faintly dusted; pleurae and metanotum more grayish, sternopleurae shining on lower portions, humeri and halteres bright yellow; legs chiefly black, apices of femora and tibiae, bases of tibiae and first four tarsal subsegments yellow; femora moderately thickened, with two rows of strong spines on apical halves below; anterior femora each with two long flexor bristles near bases below; middle coxae with a transverse row of long slender, downward directed bristles at their apices, above; posterior trochanters each with a distinctively shaped tooth-like projection on undersides near apices; this tooth directs downward for about half its length then abruptly narrows and slants toward the base of the trochanter (fig. 91a); tibiae almost straight, only slightly bowed; basitarsi equal in length to the next three tarsal subsegments. *Wings:* Hyaline, very faintly iridescent, third section of costa little less than one-half the length of the fourth; fifth costal section twice as long as third and fourth combined; crossvein r-m situated at or slightly beyond the end of vein R_1 (R_{1+2}) and just before the middle of the discal cell; last section of fourth vein (M_{1+2}) slightly curved, longer than the third section of that vein (from r-m crossvein to m); posterior crossvein (m) longer than last section of the fifth vein. *Abdomen:* Sides but gently rounding, widest at segments two to four; the pseterior portion of the abdomen is strongly bent downward. Fifth abdominal segment longer than the fourth, hypopygium about equal to the fifth in length. *Hypopygium:* With a distinct vertical keel at apex, above and a large median cleft area extending from the base almost to the keel from dorsal view (fig. 91b). The apical portion of the hypopygium is less heavily sclerotized and densely covered with short microscopic setae; this area seems to be formed by an out folding of the eighth

segment. From ventral view the ninth segment is deeply cleft, the cerci are large and rounding and the harpagones rather narrow and enlarged at their tips (fig. 91c); from lateral view it is seen that the claspers are very flat, enlarged and rounding apically; harpagones yellowish in color.

"Length: body, 2.6-2.9 mm.; wings, 2.6 mm.

"*Female.* The association of the females is not at all certain, the specimens apparently belonging to this species run to *toxodentis* (Hardy-Knowlton) and cannot be conveniently separated from that species by structural characters. The third antennal segment is yellowish instead of black and the bristles of the middle coxae are stronger and black, being bright yellow in *toxodentis.* The front of the female is entirely silvery and sunken between the eyes; base of ovipositor rather rounding, piercer much longer than base and very slender, reaching to about the middle of the third abdominal segment."

Type locality: Hilliard, Florida.

Type in Snow Entomological Collection.

Tömösváryella inconspicua (Malloch)

Pipunculus inconspicuus Malloch, 1913, Proc. U. S. Nat. Mus. 43, 295-296.

This species was described from a single female specimen and as the male was unassociated it cannot be accurately placed. Malloch allies it to *subnitens* Cresson but even this relationship is questionable. The following is the original description.

"*Female.* Frons widest at middle, where it is about one and one-half times as broad as at above antennae, nearly as broad at vertex as at antennae, silvered at lower half, dull black above, face distinctly silvered, narrower than the frons and of nearly uniform width. Occiput silvery below but on upper portion black, antennae black, third joint elongate and distinctly acuminate, silvered, especially apically, arista swollen and glossy black at base; thorax slightly gray-dusted, with scattered pale hairs, humeri whitish, with distinct, long, downy, pale hairs, pleurae gray-dusted, scutellum gray-dusted and with very few weak hairs, squamae white; abdomen short and broad, tapering toward apex, subopaque, first segment gray-dusted laterally, and with distinct lateral comb, other segments only indistinctly gray-dusted low down laterally, a few scattered hairs in the last three segments, ovipositor long, reaching to second ventral segment, distinctly longer than its base; legs black, only knees, bases of tarsi, claws and pulvilli yellowish, no distinct leg bristles and but a little pubescence present, wings clear, inner crossvein distinctly beyond end of first vein and middle of discal cell, outer crossvein slightly shorter than last portion of fifth vein; halteres with brown pedicel and whitish yellow knobs.

"Length, barely 2 mm."

Type locality: Medicine Hat, Alberta, Canada.

The writer has examined the type at the United States National Museum.

Tömösváryella lepidipes n. sp.

(Plate 16, figs. 92a-e)

This species is related to *similis* (Hough) but is readily separated by the shape of the posterior trochanters and the male genitalia; the female ovipositor also differs in shape.

Male. Frontal triangle silvery to pale golden pubescent, front above junction of eyes shining black; eyes joined for about one half the length of the frontal triangle; antennae brown to black, third segment long acuminate below (fig. 92a) and thickly white pubescent; upper portion of occiput shining. *Thorax* and *abdomen:* Metallic black in ground color, faintly brownish to gray dusted; more distinctly grayed on metanotum and sides of first and fourth terga, thorax rather sparsely haired but with distinct dorsocentrals; humeri and halteres yellow; the legs are much the same as in *similis,* the tarsi, however, are brown to black, only rarely yellowed; the posterior trochanters have distinct raised portion of the middles below, this is covered with dense yellow, microscopic hairs (fig. 92e); in this respect the species approaches *subvirescens* (Loew); the posterior femora possess numerous elongate yellow hairs on their undersides, the hind basitarsi are about as long as next four tarsal subsegments, tarsi but slightly flattened. *Wings:* As in *similis,* however, the r-m crossvein is at the middle of the discal cell and the last section of the fourth vein more consistently curved. Sides of abdomen almost straight, slightly tapering until the fifth segment; fifth abdominal segment about one and one half times as long or longer than the fourth segment; longitudinal groove located about medianly, from dorsal view (fig. 92b). From ventral view the ninth segment is slightly longer than wide with a deep 'V' shaped cleft almost half its length on posterior margin. Harpagones irregular, greatly curved, asymmetrical and rounding apically, the inner clasper is the more developed of the two (fig. 92c); inner margins of claspers not concave as in *similis.*

Length: body and wings, 2.5-3 mm.

Female. Lower one third of front silvery, upper two thirds verging from subshining to polished black. Tarsi brownish as in the male, subsegments slightly more flattened. Posterior trochanters not carinated as in the male but with a dense patch of fine hairs below. Base of ovipositor globose, piercer gradually tapering from base to apex of anal openings, then abruptly narrowing and slightly curved (fig. 92d). Piercer reaching beyond apex of second segment.

This is a widely distributed species, especially common in the west.

Holotype ♂, Fallon, Nevada, August 12, 1940 (L. C. Kuitert); allotype ♀ same locality and date (R. H. Beamer). Ninety-five paratypes from following localities:

Arizona: Chiricahua Mountains, July 4, 1940 (R. H. Beamer); Ruby, July 13, 1940 (R. H. Beamer, D. E. Hardy).

British Columbia: Kimberley, Aug. 6, St. Marys Lake.

California: Mammoth Lakes, July 29, 1940 (R. H. Beamer, D. E. Hardy, L. J. Lipovsky); Sequoia National Park, Aug. 6, 1940 (R. H. Beamer, L. C. Kuitert, D. E. Hardy); Yosemite National Park, Aug. 1, 1940, some specimens on Oak (R. H. Beamer, D. E. Hardy); Tuolumne Meadows, Aug. 1, 1940 (R. H. Beamer); Echo, Aug. 10, 1940 (D. E. Hardy).

Colorado: LaJunta, Sept. 6, 1938 (D. E. Hardy, A. T. Hardy); Maybell, Aug. 18, 1940 (R. H. Beamer).

Kansas: Stafford Co., June 30, 1934, Salt Marsh (C. W. Sabrosky); Wichita, June 29, 1934 (C. W. Sabrosky); Garnett, Aug. 29, 1939-Sept. 22, 1941 (R. H. Beamer, D. E. Hardy); Sand dunes, Medora, Sept. 2, 1929 (R. H. Painter); Cherokee Co., Sept. 2, 1940 (R. H. Beamer).

Nevada: Same as type (R. H. Beamer, D. E. Hardy, L. C. Kuitert); Austin, Aug. 12, 1940 (L. C. Kuitert).

New Mexico: Tajique, June 25, 1940 (R. H. Beamer, D. E. Hardy); Estancia, June 24, 1940 (R. H. Beamer, D. E. Hardy).

Oklahoma: Grove, 11 mi. E., May 16, 1940 (R. H. Beamer).

Pennsylvania: Germ't, June 18, 1905.

Saskatchewan: Bestville, July 5, 1923 (K. M. King).

Texas: Boca Chica, June 30, 1938 (R. H. Beamer).

Utah: Delta, Aug. 14, 1940 (R. H. Beamer, D. E. Hardy); Perry, May 1, 1939 (G. F. Knowlton, F. C. Harmston); Logan Canyon, Aug. 12, 1939 (G. F. Knowlton, G. S. Stains).

Paratypes being returned to Utah State Agricultural College; Kansas State College; Michigan State College; Philadelphia Academy of Science and Canadian National Museum.

Holotype, allotype and a large series of paratypes in the Snow Entomological Collection.

Tömösváryella minacis Hardy

(Plate 16, figs. 93a-c)

Tömösváryella minacis Hardy, 1940, Journ. Kans. Ent. Soc. 13, 110-112.

Following is the original description:

"This species is related to *similis* (Hough) but is readily separated by the development of the male clasping structures; the strongly carinated area on

the dorsum of the outer clasper, the smaller carina of the inner and the broadened apices of these structures will distinguish it; the r-m crossvein is also situated at or slightly beyond the middle of the discal cell, instead of before the middle as in *similis*.

"*Male. Head:* First two segments of antennae black, bristles of second segment short; third segment acuminate, like *similis* in shape, brownish in ground color, densely white pubescent. Face silvery, frontal triangle silvery with a light golden tinge, upper portion of front, above junction of eyes, and vertex shining black; upper portion of occiput subshining, sides silvery. *Thorax:* Shining in ground color, brownish dusted on dorsum of mesonotum and scutellum, rather lightly grayed on margins of mesonotum, distinctly gray pollinose on metanotum and upper portions of pleurae. *Legs:* For the most part, as in *similis*, the bristles of the mid-coxae are strong and yellowish to brown in color; the hind trochanters possess three to four small but distinctly visible hairs on underside near their bases and a medio-ventral patch of dense microscopic pile; this patch is located on a slightly raised area (fig. 93a), this is not distinctly tuberculate as in the vagabunda group. *Wings:* Lightly iridescent, third section of costa about one half the length of the fourth; fifth section not quite twice the length of the third and fourth combined; crossvein r-m situated well beyond the end of vein R_1 (R_{1+2}), and slightly beyond the middle of discal cell; ultimate section of fourth vein straight or nearly so, last section of the fifth about equal to the posterior crossvein in length. *Abdomen:* Chiefly shining, only lightly dusted, sides but slightly rounding; fifth segment one and one third times as long as the fourth. *Hypopygium:* About three fourths the length of the fifth segment of abdomen, the longitudinal groove located just to the left of the median line, membranous apex plainly visible and sometimes extruded. The claspers are developed dorsally into strong carinae, more pronounced on the outer clasper (fig. 93b, c), both claspers are bluntly pointed, the inner one is more slender and larger of the two and is scarcely curved inward at its apex; the outer is more stout and gently curved inward at its apex; neither clasper is concave on the inner margin as in *similis*.

"Length: body, 2.6 mm.; wings, 2.6 mm.

"*Female:* Differs in having the third antennal segment distinctly yellow, the front is silvery pollinose to the vertex, wider and distinctly concave in the middle. Crossvein r-m is situated at end of vein R_1 and distinctly before the middle of discal cell. Flexor spines of femora more developed, hind tibiae dilated on apical halves and tarsi more flattened. Base of ovipositor short and round, piercer slender, twice as long as base, reaching to apex of second abdominal segment.

"Length: body and wings, 2 mm."

Type locality: Key Largo, Florida.

Type in Snow Entomological Collection.

Tömösváryella pauca n. sp.

(Plate 16, figs. 94a-b)

This species is related to *xerophila* n. sp. by having slender obtusely pointed harpagones. It is distinguished by having ninth

segment deeply cleft on hind margin and its lateral margins more acutely pointed at apices; the harpagones are more slender and are concave on their inner margins; the compound eyes are joined on the front for about twice the length of ocellar triangle and ultimate section of fourth vein is shorter than posterior crossvein.

Male. Rather small, chiefly bare species. *Head:* Ocellar triangle and face silvery pubescent; junction of compound eyes about half as long as frontal triangle; bristles of second antennal segment weak, third segment acuminate, yellowish brown in ground color, densely white pubescent. *Thorax* (and abdomen) subshining, lightly dusted with gray on the dorsum, grayed on the sides; metanotum gray with a faint transverse furrow toward upper margin. Dorsocentral and marginal hairs very weak. Legs typical in color; front femora with a pair of weak flexor bristles below near bases; middle tibiae with three to four strong apical bristles above; hind trochanters each with an obtuse tubercle below (fig. 94a). Sides of abdomen slightly rounding, widest at segments three to four. *Hypopygium:* Scarcely as long as fifth abdominal segment, evenly compressed to the right, with longitudinal membranous area extending down the middle portion to base of eighth segment; seventh segment visible from dorsal view. From ventral view the membranous area is seen to be very large, extending more than half way to base of eighth segment. Ninth segment about as long as wide and slightly longer than sclerotized portion of eighth segment on left side. Ninth segment acutely pointed on apical margins, cleft deeply 'V' shaped, extending two thirds the length of segment on a middle line. Harpagones simple, slender and rounding apically, inner margins slightly concave. Cerci moderately developed, extending about as long as apices of ninth (fig. 94b).

Length: body and wings, 3-3.2 mm.

Female unassociated.

Holotype ♂, Homestead, Florida, July 19, 1939 (D. E. Hardy). Three paratypes (♂), Suwanee Springs, Florida, Aug. 2-3, 1939 (D. E. Hardy); Hilliard, Florida, Aug. 31, 1930 (R. H. Beamer) and Adel, Ga., Aug. 11, 1939 (R. H. Beamer). All in the Snow Entomological Collection.

Tömösváryella propinqua n. sp.

(Plate 16, figs. 95a-d)

This species is closely related to *vagabunda* but because of the notable differences in the male genitalia it is considered a distinct species. It is readily separated from *vagabunda* by the strongly

curved, slender harpagones of the male, its larger size and lack of gray pollinosity.

Male.—Submetallic black in ground color, sparsely dusted with gray. *Head:* Third segment of antenna acuminate, brown to black in ground color, densely covered with whitish pubescence; front dull grayish pubescent above antennae, shining black above the junction of eyes; eyes joined for a very short distance, this junction is scarcely longer than the length of the ocellar triangle. *Thorax* (and abdomen): A sparse pale pile on dorsum; humeri and halteres bright yellow; legs chiefly black, extreme apices of femora and tibiae and bases of tibiae yellow; front femora with a pair of long flexor bristles near bases below, middle trochanters with three to four pale bristles on apices above; hind trochanters short, little longer than wide, trochanteral development situated on apical portion below; this is rather large and obtusely pointed (fig. 95d). *Wings:* Lightly iridescent; third costal section one fourth the length of the fourth, r-m crossvein situated well beyond end of first vein and at middle of discal cell; ultimate section of fourth vein very slightly curved, petiole of cubital cell comparatively long. Sides of abdomen somewhat rounding, widest at segments three to four. *Hypopygium:* About three fourths the length of the fifth abdominal segment, with the membranous portion of the eighth segment distinctly to the left side (fig. 95a). When the hypopygium is compared to that of *vagabunda* it is seen to be twice as large. From ventral view the membranous area cuts quite deeply into the eighth sclerite; ninth segment distinctly wider than long; apical cleft broadly 'V' shaped, extending almost half the length of the segment on a middle line; at its longest point the ninth segment is shorter than the distance from the base of the ninth to the membranous area. Harpagones very irregular, strongly curved on outside edges, curved inward apically into bootlike developments (fig. 95b). The outer clasper lacks the longitudinal ridge which is characteristic of *vagabunda.*

Length: body, 2.5-2.8 mm.; wing, 2.4-2.6 mm.

Female. The females for the most part fit the characters of *vagabunda;* they are, however, of larger size, more submetallic instead of densely pollinose. The wings are lightly iridescent instead of milky white and the ovipositor tends to be more flattened dorsoventrally (fig. 95c).

This species is very widely distributed, more abundant in western America.

Holotype ♂, Oliver, B. C., Canada, 8-6-31 (J. Nottingham);

allotype ♀, same data. Two hundred and twenty-three paratypes from the following localities:

Arizona: Chiricahua Mountains, July 4, 1940 (D. E. Hardy).

British Columbia: Same as type (H. T. Peters, L. D. Anderson, M. W. Sanderson).

California: Little Lake, July 25, 1940 (D. E. Hardy); Lone Pine, July 28, 1940 (R. H. Beamer, D. E. Hardy); Kernville, July 25, 1940 (R. H. Beamer); Seeley, July 17, 1940 (L. C. Kuitert, R. H. Beamer, D. E. Hardy); Lake Tahoe, Aug. 11, 1940 (D. E. Hardy); Bishop, July 28, 1940 (D. E. Hardy); Rosemond, July 23, 1940 (R. H. Beamer, E. E. Kenaga, D. E. Hardy).

Colorado: Delta, Sept. 4, 1938 (D. E. Hardy, A. T. Hardy); Colorado Springs, 5915 ft., Aug. (E. S. Tucker); Fruita, Sept. 4, 1938 (D. E. Hardy, A. T. Hardy); Cerro Summit, El. 9,500 ft., Sept. 5, 1938 (D. E. Hardy, A. T. Hardy); Craig, Aug. 18, 1940 (R. H. Beamer); Wray, Aug. 23, 1940 (L. J. Lipovsky); Akron, Aug. 23, 1940 (R. H. Beamer).

Kansas: Wichita, June 29, 1934 (C. W. Sabrosky); Stafford Co., June 30, 1934 (C. W. Sabrosky); Douglas Co., Aug. 25, 1939 (R. H. Beamer); Manhattan, Sept. 16, 1933 (C. W. Sabrosky).

Manitoba: Treesbank, July 23, 1915 (N. Criddle).

Minnesota: Badger, July 18, 1935 (D. G. Denning); Norman Co., Aug. 1, 1923 (A. A. Nichol); Ft. Snelling, Aug. 2, 1923, High Prairie (R. W. Dawson).

Nevada: Ely, Aug. 13, 1940 (D. E. Hardy).

New Mexico: Estancia, June 24, 1940 (D. E. Hardy); Cloudcroft, June 27, 1940 (R. H. Beamer, L. J. Lipovsky, D. E. Hardy); Mountain Park, June 27, 1940 (R. H. Beamer); Santa Rosa, June 23, 1940 (R. H. Beamer, D. E. Hardy).

Texas: Romero, June 22, 1940 (D. E. Hardy).

Utah: Goshen, Aug. 16, 1940 (R. H. Beamer, D. E. Hardy, L. C. Kuitert, E. E. Kenaga); Duchesne, Aug. 17, 1940 (R. H. Beamer); Delta, Aug. 14, 1940 (R. H. Beamer, E. E. Kenaga, D. E. Hardy); Ephraim, Aug. 16, 1938 (G. F. Knowlton); Magna, Aug. 4, 1938 (G. F. Knowlton, G. S. Stains); Brigham, Aug. 12, 1938 (G. F. Knowlton, D. E. Hardy); Price, Sept. 4, 1938 (D. E. Hardy, A. T. Hardy); Brigham, July 15, 1940 (G. S. Stains, G. F. Knowlton).

Holotype, allotype and a large series of paratypes in the Snow Entomological Collection. Paratypes returned to Utah State Agricultural College; University of Minnesota; Michigan State College and the United States National Museum and Canadian National Museum.

Tömösváryella quadradentis n. sp.

(Plates 16-17, figs. 96a-d)

This species is related to *toxodentis* (Hardy-Knowlton) but is easily seperated by the large square topped processes on the hind trochanters of the male.

Male. Subopaque species, the shining black ground color being obscured by dense grayish pollen and sparse pale pile. Antennae black, third segment acuminate (fig. 96c). Eyes joined for only a short distance on the front; the length of this junction is scarcely longer than the length of the ocellar triangle. Front slightly concave on lower portion, front and face densely silvery pubescent. Humeri and knobs of halteres yellow. Legs black except for yellow apices of femora and tibiae, bases of tibiae and first two to three tarsal subsegments. Femoral spines very weak, no apparent flexor bristles at bases of front femora; middle coxae with three or more long yellow bristles at their apices above; hind trochanters each with a large square-topped development near middles below (fig. 96d). This process is somewhat oblique in position and about equal to the width of the trochanter in length. Wings milky-white, third costal section about one third the length of the fourth, fifth section about one and one half times as long as third and fourth combined. Crossvein r-m situated just beyond end of vein R_{1+2} and at about middle of discal cell; last section of fifth vein slightly sinuate. Abdomen gently tapering, widest at segments two to three. *Hypopygium:* Elongate, tapering to quite an acute point, almost twice as long as wide and distinctly longer than fifth abdominal segment. From dorsal view a distinct longitudinal groove is visible on the left side (fig. 96b). From the ventral view the eighth segment is over twice the length of the ninth and with a small membranous area at the extreme tip. The ninth segment is little longer than wide, broadly rounding on posterior apices, with a small 'V' shaped cleft on hind margin. Harpagones rather long and slender, somewhat concave on inner margins. Cerci very large and greatly curved, completely covering the bases of harpagones (fig. 96a).

Length: body, 3.3-3.8 mm.; wing, 2.7-3.1 mm.

Female. Front very broad, widened at middle portion, entirely silvery opaque. Front femora with a pair of strong flexor bristles near bases below, apical bristles of middle coxae strong and dark in color. Ovipositor rather elongate, base somewhat globose, piercer long and slender, extending to about base of third abdominal segment and about twice as long as its base; otherwise as in male.

The females appear to be inseparable from those of *toxodentis;* the wings are more milky white, however, and the ovipositor seems slightly longer.

Holotype ♂, Lone Pine, California, July 28, 1940 (D. E. Hardy); allotype ♀ same data. One hundred and sixty-six paratypes, one hundred and thirty-three ♂ ♂ and thirty-three ♀ ♀ from the following localities: Same as type (R. H. Beamer, D. E. Hardy, E. E. Kenaga); Onyx, California, July 28, 1940 (R. H. Beamer, E. E. Kenaga, D. E. Hardy); Kernville, California, July 24, 1940 (R. H. Beamer); Little Lake, California, July 25, 1940 (D. E. Hardy); Mammoth Lakes, Calif., July 29, 1940 (L. J. Lipovsky, D. E. Hardy); Mono Lake, Calif., July 31, 1940 (L. C. Kuitert); Olancha, Calif., Aug. 25, 1940 (D. E. Hardy); Fallon, Nevada, Aug. 12, 1940 (R. H. Beamer, L. C. Kuitert, D. E. Hardy) and Carson City, Nevada, Aug. 12, 1940 (R. H. Beamer, E. E. Kenaga, D. E. Hardy). All are in the Snow Entomological Collection.

Tömösváryella sachtlebeni (Aczel)

(Plate 17, figs. 97a-e)

Pipunculus sachtlebeni Aczel, 1940, Zoöl. Anzeiger, 1.12, Bd. 132, Heft 7/8, 152.
Pipunculus unguiculatus Cresson, (nec Zeller, 1860) 1911, Trans. Amer. Ento. Soc. XXXVI, 319.

This species belongs in the so-called *vagabunda* group because of the development of the hind trochanters. The shape of the trochanteral process and genital characters separate it from other species in this complex.

Male. Very similar in most respects to *similis* (Hough), although the body is more distinctly brown pollinose, the polished ground color being almost obscured by the pollen. The compound eyes are joined on the front for more than one half the length of the frontal triangle, frontal triangle silvery but with an opaque black spot in the central portion. *Legs:* Chiefly black as in other species of the complex, femora moderately thickened, spines weak on front and hind femora but rather well developed on middle pair; front femora with one to two flexor bristles near bases. Mid-coxae each with a pair of rather long bristles at their apices; hind trochanters each with a well developed slightly curved toothlike process below, near bases (fig. 97c); this process is about equal to the width of the trochanter in length and rather bluntly pointed. *Wings:* Lightly iridescent, third section of costa one third to one fourth the length of the fourth section; fifth section about one and one half times as long as third and fourth combined. Crossvein r-m situated beyond

the end of vein R_{1+2} and at the middle of the discal cell; last section of fourth vein slightly curved, last section of fifth vein shorter than the posterior crossvein (fig. 97b). *Abdomen:* Sides slightly rounding, widest at segments three and four; fifth segment about one and one third times the length of the fourth. *Hypopygium:* About equal to the fifth segment in length, slightly compressed to the right with a longitudinal groove just to the left of the median line and the membranous area projected, making a keel-like development at the apex (fig. 97d). From ventral view the membranous apex of the eighth segment is rather large, extending half the length of the segment toward the base. Claspers rather simple, slightly curved and bluntly pointed, inner clasper little longer than the outer and more distinctly curved inward at its apex. Ninth segment longer than wide with a broadly 'V' shaped cleft on hind margin, extending about one half its length on a median line; ninth segment much longer than sclerotized portion of eighth on left side, from ventral view (fig. 97e). Cerci elongate, extending much beyond apex of ninth segment.

Length: body and wings 3.2 mm.

Female unassociated.

Type locality: Falls Church, Virginia.

The writer has studied the type at the Cambridge Museum of Comparative Zoölogy and a series of topohomotypes, and has identified the species from numerous localities from the following states and Canadian province: Florida, Indiana, Iowa, Kansas, Michigan, New Jersey, Saskatchewan, Tennessee and Virginia.

Tömösváryella similis (Hough)

(Plate 17, figs. 98a-h)

Pipunculus similis Hough, 1899, Proc. Bost. Soc. Nat. Hist. XXIX, 84.

This species has been very vaguely defined and its identification could never be made certain from the original description; *similis* is near *braueri* Strobl of Europe but the third antennal segment is not so long acuminate and the hypopygium is different from that species.

Male. Almost bare species, with only scattered pale hairs on thorax and abdomen. *Head:* Face silvery, frontal triangle silvery with a golden tinge; vertex and front above junction of the eyes shining black; occiput subshining above, gray on the sides; eyes joined on the front for less than one half the length of the frontal triangle (fig. 98h); third segments of antennae yellow to yellow-

brown in ground color, acuminate below (fig. 98a). *Thorax* (and abdomen): Metallic black ground color, rather thickly covered with grayish to brown dust, this pollinosity is caused by a covering of the integument with microscopic scales. Metanotum and pleurae distinctly grayed; humeri and halteres yellow. *Legs:* Chiefly black, apices of femora and tibiae, bases of tibiae and first four tarsal subsegments yellow; apical subsegments of tarsi yellow-brown; femora only moderately thickened, spines weak, anterior pair with two distinct flexor bristles near bases; middle coxae with three, downward projecting bristles above at apices; hind trochanters with a clump of bristles or hairs on undersides near bases (fig. 98f), the size and number of these hairs appears to vary a great deal; posterior tarsi flattened, basitarsi longer than next three subsegments. *Wings:* Third costal section about one half the length of fourth, fifth section about twice as long as the third and fourth combined; crossvein r-m situated at about the end of R_{1+2} and well before the middle of the discal cell; ultimate section of fourth vein faintly curved, last section of fifth vein shorter than the posterior crossvein in length. *Abdomen:* Sides almost straight, slightly rounded at segments two to four; fifth segment one and one half times the length of the fourth; hypopygium about three fourths the length of the fifth segment (fig. 98e). *Hypopygium* compressed to the right with an apical cleft and median depression formed by the ends of the eighth tergum coming together on the dorsum. Seventh tergum rather broad, chiefly ventral in position, scarcely visible from dorsal view; sixth tergum entirely ventral with but a thin strip of the sclerite running around the left side. Ninth segment about as broad as long, with a deep 'V' shaped concavity for more than half its length on posterior margin. Harpagones almost symmetrical, the one on the inner side but slightly larger than the outer, rather slender and terminating in an acute point on inner apices; rather strongly curved and distinctly concave on inner margins (fig. 98d).

Length: body and wings, 2.2-2.7 mm.

Female. The females are difficult to separate as is typical of this genus; about the upper one half of the front is shining black, front broader than the face and depressed in the middle. The abdomen is faintly gray pollinose. Bristles of front femora, middle coxae and hair clump of hind trochanters very distinct; middle femora often with two strong bristles near bases beneath; post-tarsi strongly flattened and dilated. Base of ovipositor subglobose, piercer not much longer than base (fig. 98g). Otherwise like the male.

Type locality: Tifton, Georgia.

The writer has studied the type at the Field Museum in Chicago and has homotopotypes taken August 11, 1939 (A. T. Hardy) also homotypes from the following localities: Griffin, Georgia, 8-12-39 (R. H. Beamer, D. E. Hardy, A. T. Hardy, E. G. Wegenek); Ottawa County, Kansas, June 24, 1934; Garnett, Kansas, August 29, 1939 (R. H. Beamer). Specimens have been identified from a large number of localities in Alabama, Arizona, Kansas, Ohio, Oklahoma, Pennsylvania and Utah.

Tömösváryella sonorensis (Cole)

(Plate 17, fig. 99a)

Pipunculus sonorensis Cole, 1923, Proc. Calif. Acad. Sci., V. 12, Series 4, 467.

This species apparently belongs in the toxodentis group as the original description implies that the hypopygium is long and slender. The shape of the development on the posterior trochanter places it near *quadradentis;* this structure, however, is yellowish, square topped and extends longitudinally on the trochanter. The following is the original description:

"*Male.* Length 3 mm. Frons narrow, extending slightly over half way to posterior eye margin, silvery pollinose. Eyes touching for a very short space, the ocellar triangle narrow and black. Face silvery pollinose, slightly narrowing toward oral margin. Antennae blackish brown, third joint long and acuminate, paler on apical half, with a black arista. Occiput black, sides thinly silvery pollinose.

"Mesonotum and scutellum black, thinly gray dusted, oval in outline; humeri pale. Postnotum gray pollinose. Pleura black, gray pollinose. Part of stem of halteres brown, the knob yellowish white.

"Abdomen black, thinly gray dusted, oval in outline; pile sparse, pale, a few larger hairs at base of first segment. Hypopygium as long as fifth segment, slender, asymmetrical, largely developed on right side.

"Legs black, the apices of femora and narrow bases of tibiae yellow. Hind femora unarmed, the trochanters with a large, blunt, yellowish tooth. Hind tibiae strong, the first tarsal joint slender. Wings hyaline, the stigma hyaline. Space between apex of subcostal vein and R_1 about half that between R_1 and R_{2+3}. Small crossvein about middle of cell 1st M_2 and beyond apex of R_1. Last section of M_{1+2} (fourth vein) distinctly sinuate."

Female unknown.

Type locality: Tepoca Bay, Sonora, México.

Type at California Academy of Science.

Tömösváryella subnitens (Cresson)

(Plate 17, figs. 100a-g)

Pipunculus subnitens Cresson, 1911, Trans. Amer. Ent. Soc. XXXVI, 316.

This species belongs in the *similis* group but is readily distinguished by the gray pollinosity of the thorax and abdomen as well as by genital characters.

Male. Frontal triangle and face silvery pubescent, upper portion of front and vertex shining black; occiput chiefly cinereous, more lightly dusted above. Compound eyes joined for less than one half the length of the frontal triangle. First two antennal segments black, bristles of second segment weak; third segment yellow to yellow-brown, long acuminate below (fig. 100a) and densely white pubescent. *Thorax:* Gray pollinose, distinctly cinereous on the pleurae, metanotum, scutellum and margins of mesonotum; mesonotum with scattered pale hairs, more numerous toward the anterior portion. Humeri and halteres yellow. *Legs:* Chiefly black, extreme apices of femora and tibiae, bases of tibiae and the first four tarsal subsegments yellow, last subsegment of tarsi brown. Front femora with two small flexor bristles near bases; hind trochanter without conspicuous hairs or bristles but very slightly carinated below (figs. 100c, d); femoral bristles very weak, hairlike or wanting. Hind femora moderately thickened, hind tibiae distinctly arcuate; posterior basitarsi about as long as next four tarsal subsegments. *Wings:* Milky-white with but a very faint iridescent cast, wings short and rounding apically; third section almost three times the length of the third and fourth combined. The fork of the Rs situated before the arculus; crossvein r-m at or slightly beyond the middle of the discal cell and just before the end of vein R_{3+4}. Last section of fourth vein distinctly curved, last section of fifth about equal in length to the posterior crossvein (fig. 100e). *Abdomen:* Subshining in ground color, first segment and lateral margins of the rest of abdomen cinereous; faintly to densely gray dusted on the dorsum, the pollinosity usually obscuring the ground color. Sides slightly rounding, widest at segment three; fifth segment almost as long as third and fourth combined. *Hypopygium:* About three fourths the length of the fifth segment, slightly compressed to the right, with an apical depressed area and a median groove, formed by the coming together of the edges of the eighth tergum (fig. 100b). From ventral view the ninth segment is as broad as long and terminates apically in two rounding lobes, posterior median

margin deeply concave. Harpagones irregular, asymmetrical and bluntly pointed (fig. 100g).

Length: body, 2.8 mm.; wings, 2.5 mm.

Female. Front broader than the face and sunken in the middle, chiefly silvery, shining black on upper one third. Thorax usually less grayed above and pollinosity of abdomen more generalized than in the male. Ovipositor rather short; base globose, piercer about equal in length to its base (fig. 100f) and reaching to about the apex of the third abdominal segment. Tarsal subsegments flattened and rather broad; otherwise like the male.

Length: body, 2.8 mm.; wings, 2.3 mm.

Type locality: Alamogordo, New Mexico.

The writer has studied the type at the Philadelphia Academy of Science and has homotypes from Laramie, Wyoming, 6-23-35 (R. H. Beamer, Jack Beamer) and Cuyama Ranch, Calif., 7-25-35. (R. H. Beamer).

This is a common western species. Specimens have been determined from numerous localities in the following states: Arizona, California, Colorado, Kansas, Nevada, New Mexico, and Utah.

Tömösváryella subvirescens (Loew)

(Plate 17, figs. 101a-e)

Pipunculus subvirescens Loew, 1872, Centuria X, Berl. Ent. Zeitsc. XVI; 87. Type male No. 456 examined in Cambridge Museum of Comparative Zoölogy.

Pipunculus pilosiventris Becker, 1900, Berl. Ento. Zeitschr. XLV, 233. New synonymy.

Pipunculus aridis Williston, 1893, North American Fauna, VII, 255. (Synonymy by Hough, 1899, Proc. Bost. Soc. XXXIX, 78).

Pipunculus albiscta Cresson, 1911, Trans. Amer. Ento. Soc. XXXVI, 318. New synonymy.

Pipunculus insularis Cresson, 1911, Trans. Amer. Ento. Soc. XXXVI, 317-318. New synonymy by comparison of types.

Pipunculus metallescens Malloch, 1913, Proc. U. S. Nat. Mus. 43, 298. New synonymy by study of type male.

Pipunculus knowltoni Hardy, 1939, Jour. Kans. Ent. Soc. vol. 12, 20-22. New synonymy by type comparison.

Pipunculus translatus Walker? 1857, Trans. Ento. Soc. London, IV, 150. Cresson has suggested that this possibly belongs here but as its position is questionable *subvirescens* is not being considered a synonym.

Synonymy of *pilosiventris* Becker was discovered by Aczel after the writer had presented him with American specimens of Loew's species. *P. pilosiventris* had been known from Egypt, from Palearctic region, Mediterranean subregion and from Abyssinia (Ethiopia), Ethiopian region, East African subregion.

P. albiseta Cresson synonymy by comparison of type female with a series of *subvirescens* females which had been associated with the males; it possesses the identical characteristics.

P. knowltoni Hardy was proposed as a new species on a basis of the striking post-trochanteral character of the males (fig. 101a).

This character has been omitted in other descriptions and represents one of the best characters for separation of the species.

Examination of the type of *subvirescens* cleared up one of the most perplexing problems in the DORILAIDAE. The true identity of the species has long been unkown. It has heretofore been considered very near and difficult to separate from *similis* (Hough) and this general complex has been known as the *subvirescens* group; the species actually keys into a different group by having the male hypopygium symmetrical.

The species is easily recognized by the symmetrical hypopygium and the flat-topped development on the hind trochanters of male.

Male. Chiefly subshining to metallic black species, faintly dusted on the thorax and abdomen. Eyes contiguous for about one third the length of the front, antennae typical of the genus, third segment acuminate with whitish pubescence. Humeri whitish, halteres yellow. Legs rather typical except for the distinctive developments on the posterior trochanters. Wings typical for genus. Sides of abdomen almost straight, fifth segment one and one third longer than fourth. *Hypopygium:* Three fourths as long as fifth segment, subhemispherical, not compressed, with a distinct cleft on right side. The cleft on the right side of hypopygium is formed by the junction of the margins of eighth sclerite; the seventh and ninth segments are usually visible from above. The membranous depressed area of the eighth is distinct and on the right side (fig. 101b). The ninth segment is short and rounding, as broad as long and 'U' shaped cleft on posterior margin. Harpagones very irregular and asymmetrical (fig. 101c-e) with numerous carinae and furrows longitudinally. The inner harpagone is very flat laterally (fig. 101d) and the outer is larger, more irregular from this view (fig. 101c).

Length: body, 3 mm.; wing, 3.3 mm.

Female. The front is entirely silvery, sometimes faintly shining near vertex. Ovipositor short, piercer not much longer than base; base with a small tubercle below.

Type locality: Belfrage, Texas.

The writer has studied the type at the Cambridge Museum of Comparative Zoölogy.

The species has an unusual range, which accounts for some of the synonymy; specimens have been identified from Perú, Bermuda Islands, Cuba, Nicaragua and almost every state and Canadian province. The writer has found them to be one of the most abun-

dant species affecting leafhoppers in Bermuda grass. Ashmead[31] believes this species to be parasitic upon *Draeculacephala versata* but this is unconfirmed.

Tömösváryella sylvatica (Meigen)

(Plate 17, figs. 102a-f)

Pipunculus sylvaticus Meigen, 1824, System. Beschr. IV, 20.
Pipunculus scoparius Cresson, 1911, Trans. Am. Ent. Soc. XXXVI, 317.
Pipunculus hirticollis Becker, 1910, Deut. Ent. Zeit. Berlin, 657.

This species is related to *coquilletti* (Kertesz) by having strong bristles on hind trochanters, but the two are most easily separated by use of the male genitalia; the long slender harpagones will distinguish it.

Male. Head: Face silvery, frontal triangle silvery to golden pubescent; upper portion of front shining black; eyes joined for about one third the length of the frontal triangle; antennae black, third segment acuminate, bristles of second segment weak (fig. 102a). *Thorax* and *abdomen:* Metallic black, very faintly dusted, the ground color scarcely obscured; metanotum, parts of pleurae and first abdominal segment more distinctly grayed; mesonotum with distinct dorsocentral hairs; abdomen sparsely haired, these are more abundant and more bristlelike on the sides of the fourth and fifth terga; legs chiefly black, only extreme apices of femora and tibiae, broad bases of tibiae and first four tarsal subsegments yellow, last subsegments of tarsi brown; femora normal in thickness, without any noticeable flexor spines developed, front femora lacking the usual pair of basal flexor bristles; mid-coxae with three to five strong bristles projecting downward from their apices; hind trochanter with two to five very strong bristles below (fig. 102e); posterior tibiae slightly surved; posterior basitarsi but little longer than the next three subsegments. *Wings:* Faintly iridescent, third section of costa almost one half the length of the fourth; fifth section one and one half times as long as the third and fourth combined; crossvein r-m situated beyond the end of vein R_{1+2} and about at the middle of the discal cell; ultimate section of fourth vein slightly curved. Sides of abdomen almost straight, scarcely any difference in width from the first to fifth segments; fifth segment only a little longer than the fourth. *Hypopygium:* About equal to the fifth segment in length in normal position, but it is usually somewhat extended so that the seventh and ninth segments are plainly visible from a dorsal view. Hypopygium slightly compressed to the right with an apical depressed area and a median

31. 1895, "Notes on Cotton Insects Found in Mississippi." Insect Life, VII, 326 (*Diedrocephala.*)

groove on the right side (fig. 102d). From ventral view the ninth segment is but little longer than wide and rather deeply concave on posterior margin. The harpagones are elongate, slender and simple, almost symmetrical (fig. 102e).

Length: body and wings, 3.2-3.4 mm.

Female. Third antennal segment with a tinge of yellow in ground color; front shining on upper one third to one fourth, wider in the middle than width of face. Front femora each with a pair of strong flexor bristles; mid-femora with one to two strong basal bristles beneath; posterior trochanters with a small clump of stout bristles, usually about three in number and not nearly as strong as in the males; hind tibiae somewhat enlarged apically; hind tarsi flattened and dilated. Base of ovipositor subglobose; piercer much longer than base and extending almost to base of second abdominal segment.

Described from Europe. The type is probably in the Museum of Paris.

The writer has studied the type of *scoparius* at the Boston Museum of Natural History and compared a large series of homotypes. It is widely distributed throughout Europe and America, and has been identified from the following states and Canadian provinces: Arizona, British Columbia, California, Colorado, Georgia, Iowa, Kansas, Manitoba, Massachusetts, Michigan, Minnesota, Nevada, New Hampshire, New Mexico, New York, North Carolina, Ohio, Quebec, Rhode Island, Saskatchewan, South Dakota, Tennessee, Texas, Utah, Vermont and Virginia.

Tömösváryella toxodentis (Hardy-Knowlton)

(Plate 18, figs. 103a-b)

Pipunculus toxodentis Hardy-Knowlton, 1939, Ann. Ento. Soc. Amer. XXXII, 118-120.

This is a very well defined species and can be separated from all other *Tömösváryella* by the shape of the process on the hind trochanter of the male and the peculiar hypopygium.

The following is the original description:

"*Male.* Front, face and occiput silvery pruinose. Second segment of antennae black with short black bristles above; third segment acuminate brownish with hoary tinge, whitish fringed. Humeri and halteres yellow-white, the bases of the halteres brown. Dorsum of thorax subshining with gray pollen on the sides and on the scutellum; the entire dorsum of thorax and abdomen rather thickly covered with pale brownish hairs. Pleurae, sternum, coxae and femora (except yellow apices) black, dusted with grayish; meso-coxae with a clump of long black hairs on the inner edge apically. Trochanters more shining, with a long curved tooth on each, near base (fig. 103b). Tibiae narrowly

yellowed at bases and apices, otherwise black; posterior tibiae but slightly curved. Tarsi yellow, first tarsal segment slightly longer than next three segments and about three times as long as segment five. Spines of femora and tibiae not strongly developed.

"Abdomen covered with short black hair, denser and longer on lateral margins of the posterior segments, the last few segments of abdomen usually curved downward, and the genitalia sometimes curved beneath the abdomen. Abdomen subshining metallic, slightly pruinose on the sides. Lateral comb of first segment composed of numerous long yellow-brown hairs. Hypopygium elongate, slightly longer than fifth segment and tapering to a blunt point (fig. 103a), compressed to left but with a small dorsal cleft at middle near the base and extending down right side.

"Wings hyaline with a light brownish tinge, stigma not colored.

"Length: wing, 3.2-3.4 mm.; body, 3.3-3.5 mm.

"*Female.* Front silvery to just below ocelli, slightly concave in the middle; occiput dull black above, silvery on the sides. Abdomen shining, only dusted on the sides. Piercer of ovipositor elongate, about twice as long as its base and reaching almost to the base of the addomen or at least to second segment. Posterior trochanters with a small clump of short yellow hairs basally, beneath, front femora with two long hair-like bristles on the underside near bases."

Type locality: Salt Lake City, Utah.

Type in United States National Museum Collection.

This is a common western species, having been taken in a number of localities in the following states: California, Colorado, Kansas, New Mexico, Texas, Utah, Wyoming.

This species was taken in abundance in association with *Dicyphonia* at Goshen, Utah.

Tömösváryella tumida Hardy

(Plate 18, figs. 104a-c)

Tömösváryella tumida Hardy, 1940, Journ. Kans. Ent. Soc. 13, 112-113.

Following is the original description:

"This species is related to *vagabunda* (Knab) but is readily separated by the male genital structures.

"*Male. Head:* First two segments of antennae brown to black, third segment brown, with a distinct yellow tinge in ground color and terminating in a slender acuminate point below. Face silvery, frontal triangle golden; front, above junction of eyes, black. Eyes joined for less than one half the length of the frontal triangle. *Thorax:* Metallic black in ground color, dusted with brown on the dorsum, faintly grayish on the upper portions of the pleurae, metanotum and margins of mesonotum; dorsocentral hairs weak. Legs chiefly black, narrow apices of femora and tibiae, broad bases of tibiae and first four tarsal subsegments yellow, apical subsegments of tarsi brown. Femora rather slender, spines very weak; front femora each with two small flexor bristles near bases; middle coxae with three to four strong apical bristles; hind trochanters with a distinct moundlike development on the undersides near apices (fig. 104a), this is fringed with dense white pile. Hind tarsi almost straight, with

just a slight curvature; tarsi slightly flattened, basitarsi about equal to the next four tarsal subsegments in length. *Wings:* Distinctly infuscated and iridescent, third section of costa less than one half the length of the fourth; fifth section about equal to the third and fourth combined. Crossvein r-m situated at the end of vein R_1 (R_{1+2}) and well before the middle of the discal cell. Ultimate section of fourth vein almost straight, last section of fifth vein about equal to posterior crossvein in length. *Abdomen:* Polished black only very faintly dusted on the dorsum, the ground color scarcely obscured; rather short, but little longer than the thorax, the sides gently rounding, widest at segment three. *Hypopygium:* Slightly compressed to the right, the longitudinal groove is just to the left of a median line, the membranous apex is distinct and slightly protruded (fig. 104b); hypopygium about three-fourths the length of the fifth segment. From ventral view the ninth segment is but little longer than wide, with a deep V-shaped cleft for almost half its length on posterior margin. Harpagones board and strongly developed, asymmetrical, the inner clasper being the larger of the two; these are rather acutely pointed on inner apices, distinctly concave on inner margins and each with a pronounced niche near bases on outer margins (fig. 104c).

"Length: body, 2.5 mm.; wings, 2.4 mm.

"*Female.* Front chiefly silvery with only extreme upper portion, just below vertex, shining black; third segment of antennae more distinctly yellow; flexor bristles at base of front femora more distinct than in male, bristles of middle coxae weaker; posterior trochanters without tubercles but with a patch of short hairs below, near bases; tarsi more flattened. Base of ovipositor globose, piercer almost twice as long as base and reaching just past the apical margin of the second abdominal segment."

Type locality: Belle Glade, Florida.

Type in Snow Entomological Collection.

The species is widely distributed, having been identified from the following states: California, Colorado, Georgia, Kansas, Nevada, New Mexico, and Utah.

Tömösváryella turgida Hardy

(Plate 18, figs. 105a-c)

Tömösváryella turgida Hardy, 1940, Journ. Kans. Ent. Soc. 13, 113-114.

This is a well defined species, characterized by its large blunt trochanteral developments, the large cerci and divergent harpagones.

Following is the original description:

"*Male. Head:* Face and frontal triangle silvery, front shining black above junction of eyes; compound eyes joined for about one third the length of the frontal triangle. Antennae brown to black, third segment acuminate, rather thickly white pubescent; bristles of second segments short. *Thorax* and *abdomen:* Polished in ground color, rather heavily gray to brown pollinose; margins of mesonotum and scutellum with distinct hairs, dorsocentral hairs strong; abdomen almost bare. Legs chiefly black, apices of femora and tibiae, bases of tibiae and first four tarsal subsegments yellow, apical subsegments of tarsi brownish. Femora moderately thickened, spines weak, strongest on mid-

femora; front pair each with a pair of flexor bristles near bases; middle coxae with three to four long yellow bristles apically. Posterior trochanters armed with a large blunt process in middle on their undersides, this development is about as long as the thickness of the trochanter at apex and about as thick as the trochanter at base (fig. 105b). Hind tibiae enlarged apically; hind tarsi flattened laterally basitarsi about equal to next four tarsal subsegments. *Wings:* The third costal section is about one third the length of the fourth; the fifth is about one and one half times the length of the third and fourth combined. Crossvein r-m is situated much beyond the end of the vein R_1 (R_{1+2}) and at the middle of discal cell. Last section of fourth almost straight, last section of fifth slightly shorter than the posterior crossvein. Abdomen slender, slightly bulged at segments two and three and narrowing gradually towards the hypopygium; fifth abdominal segment but little longer than the fourth. *Hypopygium:* Almost equal to the fifth segment in length, eighth sclerite rather sharply pointed at apex on the right; apical depression very distinct and about in the middle; longitudinal groove slightly to the left of a median line; the membranous area is not protruded (fig. 105a). Ninth segment rather deeply V-shaped cleft on hind margin, longer than wide; claspers fairly simple, almost symmetrical, widely diverged toward their apices, not paralleled as in most species (fig. 105c).

"Length: body, 2.8 mm.; wings, 2.7 mm.

"*Female.* The association of the female cannot be certain, the specimens at hand apparently belong here. The front is silvery to the vertex; hind trochanters normal in shape, tarsi more flat and dilated. Base of ovipositor subglobose, piercer longer than base reaching beyond the apex of second segment."

Type locality: Griffin, Georgia.

Type in Snow Entomological Collection.

The species is known from the following states and Canadian province: Arizona, Georgia, Kansas, Nevada, California, Ohio, Texas and Saskatchewan.

Tömösváryella utahensis (Hardy-Knowlton)

(Plate 18, figs. 106a-d)

Pipunculus utahensis Hardy-Knowlton, 1931, Ann. Ento. Soc. Amer. XXXII, 122-123.

This species is related to *wilburi* (Hardy) and *sachtlebeni* (Aczel) but differs from these in the development of the bristles of the middle coxae and the process of posterior trochanters and the characters of the hypopygium.

Male. Subshining black to metallic. Eyes joined for about one third the length of the front. Antennae typical. *Legs:* Typical in color, middle coxae with four to five, distinctly separated, black bristles (fig. 106b). Wings typical for the genus. Posterior trochanters each with a sharply pointed process near bases below (106c). Sides of abdomen almost straight. *Hypopygium:* Compressed to the right with a longitudinal groove just off the median

line on the left side, membranous portion usually projecting slightly at the apex; seventh tergum just barely visible, on the left side, from above (fig. 106d). From a ventral view the ninth sclerite is longer than wide and with a rather shallow concavity on its posterior margin. Harpagones rather simple, almost symmetrical, somewhat concave on inner margins and gently curved; rounding apically. Cerci extremely large, strongly sclerotized, almost covering bases of claspers (fig. 106a). This character is very good for distinguishing the species.

Female. Face and lower portion of front silvery, upper portion shining black with a narrow shining ridge down middle. Front femora each with two long flexor bristles near bases below; hind trochanters with small clumps of short hairs beneath. Piercer of ovipositor slender, extending to second abdominal segment, base globose.

Type locality: Lehi, Utah.

Type in United States National Museum Collection.

The species is known from numerous localities in Arizona, California, Colorado, Minnesota, Nevada, New Mexico, Ontario, Saskatchewan, Utah and Wyoming.

This species is collected commonly in Bermuda grass.

Tömösváryella vagabunda (Knab)

(Plate 18, figs. 107a-e)

Pipunculus vagabundus Knab, 1915, Proc. Biol. Soc. Wash., 28.

Pipunculus trochanteratus var. *tenellus* Hardy-Knowlton, 1939, Ann. Ent. Soc. Amer. XXXII, 121. New synonymy.

Comparison of specimens of *tenellus* with the type of *trochanteratus* Malloch (nec Becker) proved it to belong to a distinct species and not a variety as was formerly considered. The genital characters separate it readily from *columbiana* (change of name for *trochanteratus*). Comparison of *tenellus* specimens with the type of *vagabundus* (Knab) indicated that they might be the same. The single male specimen (holotype) in the type series of *vagabundus* is in poor condition; the trochanters are glued together so their structure cannot be seen; the abdomen is more subshining than in typical *tenellus* and the genitalia are not visible, but cinereous pollinosity is variable for the species. The original description is not ample to distinguish this species. In light of the evidence presented by life history studies there is little doubt that this is the species reared from *Eutettix tenellus* by Severin as it is definite that this is the important beet leafhopper parasite in the west.

Male. Small, rather densely gray pollinose species, with sparse pale pile on dorsum of thorax and abdomen. *Head:* Face and frontal triangle silvery white; front above junction of eyes shining black; eyes joined for about one third the length of the frontal stripe; first two antennal segments black; third segment yellowish to brown with a faint yellowish tinge in ground color, acuminate and densely white pubescent (fig. 107a). *Thorax:* Brownish to gray dusted above, scutellum, metanotum, margins of mesonotum and upper portions of pleurae grayish pubescent; sternopleurae chiefly polished black; legs chiefly black, femora rather slender, flexor spines distinct only on apical third of middle femora; front femora each with a pair of bristles below near bases; mid-coxae with three to four thin but rather elongate bristles at apices; hind trochanters each with a pronounced rounding tubercle near middles below (fig. 107b); hind tibiae almost straight; tarsi only slightly flattened, basitarsi longer than next three subsegments. *Wings:* Lightly iridescent, third costal section about one third the length of the fourth; third and fourth combined are about half the length of the fifth section; crossvein r-m situated just beyond the end of vein R_{1+2} slightly before the middle of discal cell; ultimate section of fourth vein almost straight, last section of fifth slightly shorter than posterior crossvein. *Abdomen:* Rather distinctly gray pubescent, especially on first tergum and on margins; sides of abdomen broadest at segments two to four, tapering at segment five; fifth segment one and one half times as long as the fourth. *Hypopygium:* About three fourths as long as fifth, the longitudinal groove situated just to the left of a median line; membranous apical portion somewhat protruded (in all the specimens at hand); hypopygium strongly compressed to the right (fig. 107d). From ventral view the ninth segment is about as wide as long, with a broad 'V' shaped concavity on posterior margin, clasper rather irregular, curved inward at their apices and somewhat carinated above (fig. 107e).

Length: body and wings 1.7-2.5 mm.

Female. Upper third of front shining black, with a narrow black stripe extending down into the silvery portion. Tarsi brown, flattened and dilated. Base of ovipositor globose, piercer a little longer than base (fig. 107c) and reaching to second abdominal segment, hind trochanters normal. Usually more grayed than the males, with the wings distinctly milky white.

Type locality: King City, California (reared from beet leafhopper, *Eutettix tenellus*).

The writer has studied the type at the United States National Museum.

The large collection of Dorilaidae reared from *Eutettix tenellus* and collected on beet leafhopper hosts by C. F. Henderson and the beet leafhopper parasite studies by Dr. G. F. Knowlton, Severin, et al. proved *vagabunda* to be the main species concerned in parasitism of this major pest. This collection indicates that *vagabunda* and *Dorilas subopacus industrius* (Knab) are probably the only ones which parasitize this leafhopper in the west. These were the only species reared in the Henderson collection and with the exception of one specimen of *Tömösváryella subvirescens* were the only species taken in the sweepings on the leafhopper hosts *Salsola pestifer*, *Sofia*, et al. Specimens have been taken in *Ceanothus* and may parasitize other leafhoppers besides *E. tenellus*.

This is one of the common American species, being especially abundant in the western states. Because of its ubiquity only the state records are given here, the exact localities are perhaps of little consequence. In the order of abundance of locality records for the species are as follows: Idaho, Utah, California, Oregon, Nevada, Colorado, Wyoming, Oklahoma, Arizona, Kansas, Michigan, Saskatchewan, South Dakota, Washington, Texas, Iowa, New Mexico, Georgia, Florida, Ohio and Virginia.

Tömösváryella wilburi (Hardy)

(Plate 18, figs. 108a-e)

Pipunculus wilburi Hardy, 1939, Journ. Kans. Ent. Soc. XII, 22-23.

This species is more closely related to *utahensis* (Hardy-Knowlton) but is easily distinguished by the elongate spurlike process on the middle coxae as well as by genital characters.

Male.—Eyes joined for about one third the length of front. Antennae typical. Thorax and abdomen subshining black, lightly dusted with gray. *Leg:* Typical in color, front femora each with a pair of small flexor spines below, near bases. Middle coxae apparently with a strong spur at each of their apices; this spurlike development is actually composed of four to five long flat bristles which lie so close together that they give the appearance of a single trochanteral development (fig. 108a, b); *utahensis* has two or three narrow much shorter bristles which are distinctly separated (fig. 106b). Processes of hind trochanters rather long and acute (fig. 108c). Femoral spines weak, not at all developed except on apical third. Dorsum of thorax and humeri with scattered black hairs.

Humeri whitish yellow, halteres yellow. Wings rather typical of genus, third costal section about one third the length of fourth. Sides of abdomen almost straight, slightly widest at segments two and three. *Hypopygium:* Compressed to the right, elongated and somewhat pointed apically. No distinct longitudinal groove, the margins of the eighth sclerite apparently grown together on the dorsum, a slight depressed area toward the left side gives indication of this junction. Membranous portion distinct and usually protruded at apex (fig. 108e). Membranous portion much larger than in *utahensis,* being longer than sclerotized portion of eighth segment on left side from ventral view; the ninth segment is also longer than this portion. From ventral view the ninth sclerite is longer than wide, with a shallow concavity apically; the anal plates cover most of the bases of the claspers. Claspers rather simple, rather flattened laterally and spoonlike on inner margins (fig. 108d), more deeply excavated than in *utahensis.*

Length: body, 3.1 mm.; wing, 3.4 mm.

Female. "Front silvery to the vertex, concave in the middle. Front and middle femora with two to three stout black hairs on undersides near bases; post-trochanters with a small clump of short, black hairs beneath. Piercer of ovipositor slender, reaching past posterior margin of second segment, gradually tapering from its globose base."

Type locality: Manhattan, Kansas.

Type at Kansas State College.

This species is very abundant in the middle west and is known from the following states: Colorado, Iowa, Kansas, Missouri, New Mexico and Wyoming.

Tömösváryella xerophila n. sp.

(Plate 18, figs. 109a-e)

This species is related to *vagabunda* but differs from all other species in this complex by having the male harpagones bluntly tipped, rounding apically, simple in shape without dorsal carinae or concave inner margins and the apical cleft of ninth segment very shallow. The very short junction of the compound eyes is also characteristic.

Male. Small, subshining and chiefly bare species. *Head:* Just a few of the facets of eyes touching on the upper portion of the front, eyes otherwise separated; frontal triangle and face silvery pubescent, upper portion of front shining black; antennae black,

third segment acuminate (fig. 109a), rather densely white fringed below; mouthparts yellow. *Thorax:* Shining black in ground color, lightly dusted with brown on the dorsum, faintly grayed on pleurae and margins of mesonotum and scutellum; metanotum more cinereous, with faint indication of a transverse furrow; dorsocentral and marginal hairs strong, a prominent row of yellow hairs on anterior margin of mesonotum. *Legs:* Typical of the genus in coloration, hind trochanters each with a moundlike development beneath, near apical portion (fig. 109b); middle coxae with weak apical bristles; front femora each with a pair of moderately strong flexor bristles near bases, below. *Wings:* Rather typical, broadly rounding, third section of costa about one third the length of fourth; fifth section twice as long as third and fourth combined; crossvein r-m somewhat oblique, situated just beyond the middle of discal cell and at about middle of third costal section; ultimate section of fourth vein slightly sinuate. *Abdomen:* Subshining in ground color but rather thickly grayish pruinose; sides almost straight but slightly wider at segments three to four. *Hypopygium:* Evenly compressed to the right, a little more than three fourths the length of the fifth abdominal segment; the longitudinal membranous area is situated at about the middle on the dorsum (fig. 109d). From ventral view the eighth segment is rather elongate with an extensive membranous portion. The ninth segment is about as wide as long and its length is about equal to that of the sclerotized portion of the eighth on the left side; apical cleft of ninth segment very shallow and broadly "V" shaped. Harpagones simple, rather broad and rounded apically (fig. 109e).

Length: body and wings 2.4 mm.

Female. Third segments of antennae yellowish; front broad, somewhat concave at median portion, entirely silvery. Base of ovipositor subglobose; piercer long and slender, reaching to about posterior margin of second abdominal segment and almost twice as long as its base (fig. 109c); there is no line of articulation separating the piercer from its base.

Holotype ♂: Cuervo, New Mexico, June 23, 1940, (D. E. Hardy); allotype ♀ same data as type. Thirty-nine paratypes, twenty-nine ♂♂ and ten ♀♀ from the following localities: Same as type (R. H. Beamer, L. C. Kuitert, D. E. Hardy); Chiricahua Mountains, Arizona, Rustlers Park, July 5, 1940 (D. E. Hardy); Olancha, California, August 25, 1940 (D. E. Hardy); Amarillo, Texas, July 7, 1927 (L. D. Anderson); Romero, Texas,

June 22, 1940 (D. E. Hardy). All are in the Snow Entomological Collection.

Most all the specimens in the type series were taken in a typical desert habitat by sweeping short clump grass. Leafhoppers of the genus *Athysanella* were abundant and may serve as the host for this species.

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PLATE I

FIG. 1. *Dorilas ater* (Meigen). a. mouthparts, lateral view; lab. = labellum, ha. = haustellum, lbr. = labrum, ros. = rostrum, mx. p. = maxillary palpus, ap. = apodeme, thy. = thyroid (mentum).

FIG. 2. *Tömösváryella wilburi* (Hardy). a. mouthparts, lateral view; b. mentum (thyroid), ventral view; c. maxillary palpus; d. last three subsegments of tarsus and pretarsus of middle leg, emp. = empodium, cl. = claw, pul. = pulvilli, aux. = auxilae, ung. = ungitractor; e. male genitalia, dorsal view showing muscles of left harpagone; f. aedeagus and its musculature, dorsal view of left side, diagrammatic.

FIG. 3. *Dorilaidae sp.*? a. larva from *Erythroneura sp.*?, anterior end; b. *Tömösváryella vagabunda* (Knab), mandible of last instar larva from *Eutettix tenellus* (Baker).

FIG. 4. Stigmal areas of *Dorilaidae* larvae. a. *Dorilaidae sp*? from *Ballana sp*?, posterior area of last instar; b. same larva as a., anterior area; c. *Dorilaidae sp.* from *Gypona sp.?*, posterior stigmal area; d. *Dorilaidae sp.*?, posterior area of last instar larva from *Ophiola sp.*?

FIG. 5. *Prothechus auctus* (Fallen). a. antenna; b. wing; c. abdomen of male, dorsal view.

FIG. 6. *Jassidophaga fasciata* (Hardy). a. antenna. b. male hypopygium, dorsal view; c. female ovipositor, dorsal view; d. female ovipositor and posterior portion of abdomen, lateral view.

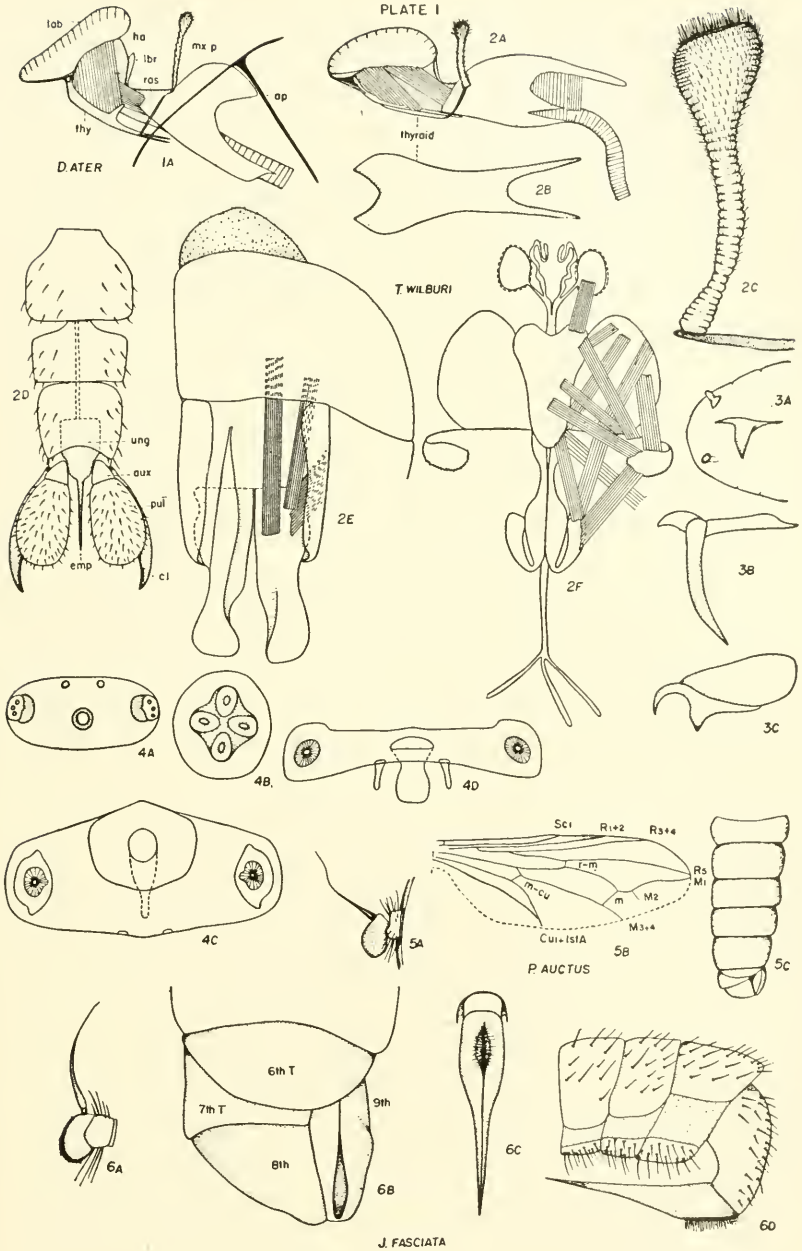


PLATE I
lab
ha
lbr
ros
mx p
op
thy
D. ATER
1A
2A
thyroid
2B
2C
T. WILBURI
2D
ung
aux
pul
emp
cl
2E
2F
3A
3B
3C
4A
4B
4D
4C
5A
Sc1
R1+2
R3+4
r-m
R5
M1
m-cu
m
M2
M3+4
Cu1+1stA
5B
P. AUCTUS
5C
6A
6th T
7th T
8th
9th
6B
6C
6D
J. FASCIATA

PLATE II

FIG. 7. *Jassidophaga pilosa* (Zetterstedt). a. male hypopygium, dorsal view; b. wing; c. female adbomen, lateral view.

FIG. 8. *Chalarus latifrons* n. sp. a. antenna; b. male hypopygium, dorsal view; c. hypopygium, ventral view.

FIG. 9. *Chalarus spurius* (Fallen). a. head, lateral view; b. wing; c. male hypopygium, ventral view; d. hypopygium, dorsal view; e. harpagones, lateral view; f. female abdomen, lateral view; g. ovipositor, dorsal view.

FIG. 10. *Nephrocerus daeckei* Johnson. a. head, lateral view; b. wing; c. female ovipositor, lateral view.

FIG. 11. *Cephalosphaera acuminata* (Cresson). a. antenna; b. hind tibia, male; c. female ovipositor, lateral view; d. male hypopygium, ventral.

FIG. 12. *C. appendiculata* (Cresson). a. antenna; b. posterior tibia of male; c. middle tibia; d. female ovipositor, lateral view; e. male hypopygium, lateral view; f. hypopygium, dorsal; g. hypopygium, ventral; h. wing.

PLATE 2

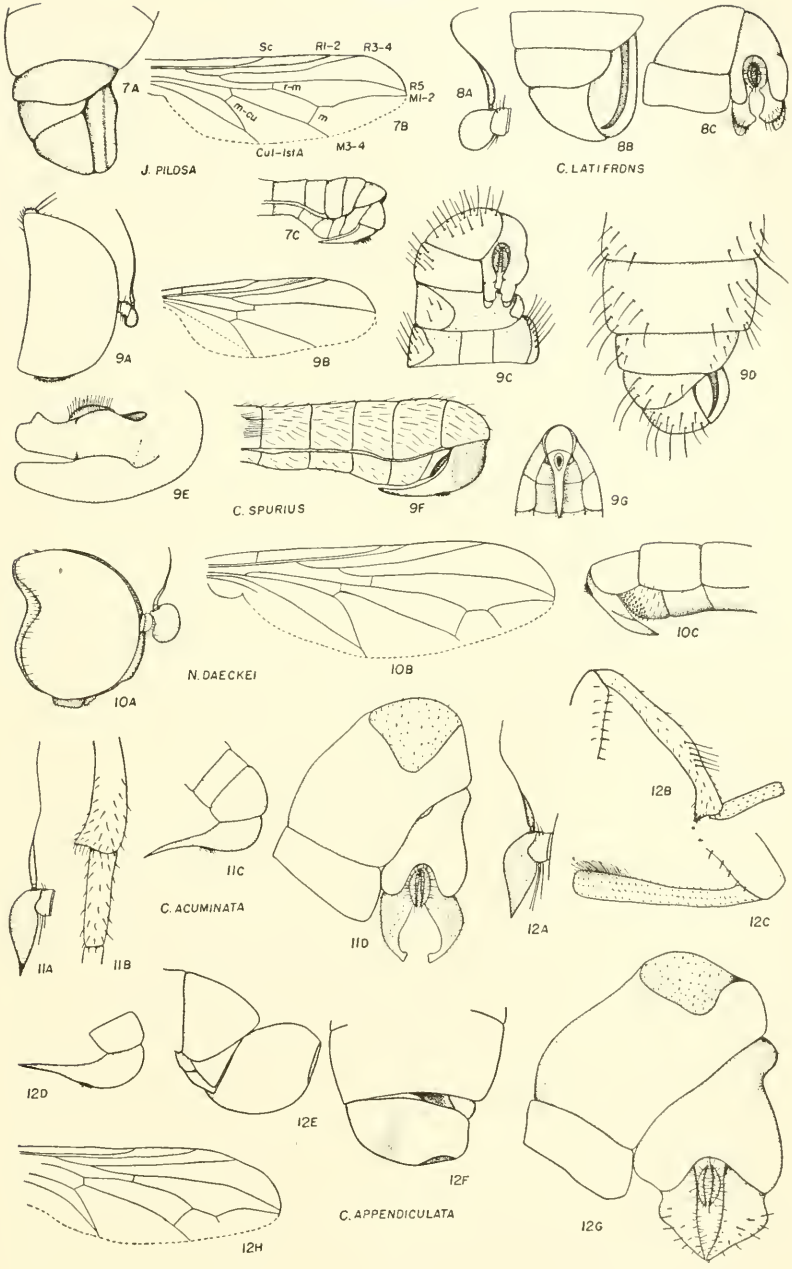

7A
Sc
RI-2
R3-4
r-m
R5
MI-2
m-cu
m
7B
CuI-IstA
M3-4
J. PILOSA
8A
8B
8C
C. LATIFRONS
7C
9A
9B
9C
9D
9E
C. SPURIUS
9F
9G
10A
N. DAECKEI
10B
10C
11A
11B
11C
C. ACUMINATA
11D
12A
12B
12C
12D
12E
12F
C. APPENDICULATA
12G
12H

PLATE III

FIG. 13. *C. biscaynei* (Cresson). a. antenna; b. wing; c. female abdomen, lateral view; d. male abdomen, dorsal view.

FIG. 14. *C. brevis* (Cresson). a. antenna; b. wing; c. male abdomen, dorsal; d. female ovipositor, lateral.

FIG. 15. *C. constricta* (Banks). a. antenna; b. wing; c. female abdomen, lateral; d. male abdomen, dorsal; e. male hypopygium, ventral view.

FIG. 16. *C. maxima* n. sp. a. antenna; b. wing; c. male hypopygium, lateral; d. hypopygium, dorsal; e. female ovipositor, lateral; f. hypopygium, ventral.

FIG. 17. *C. tibialis* n. sp. a. antenna; b. posterior tibia of male; c. costal margin of wing; d. male hypopygium, ventral; e. hypopygium, dorsal; f. female ovipositor, lateral.

PLATE 3

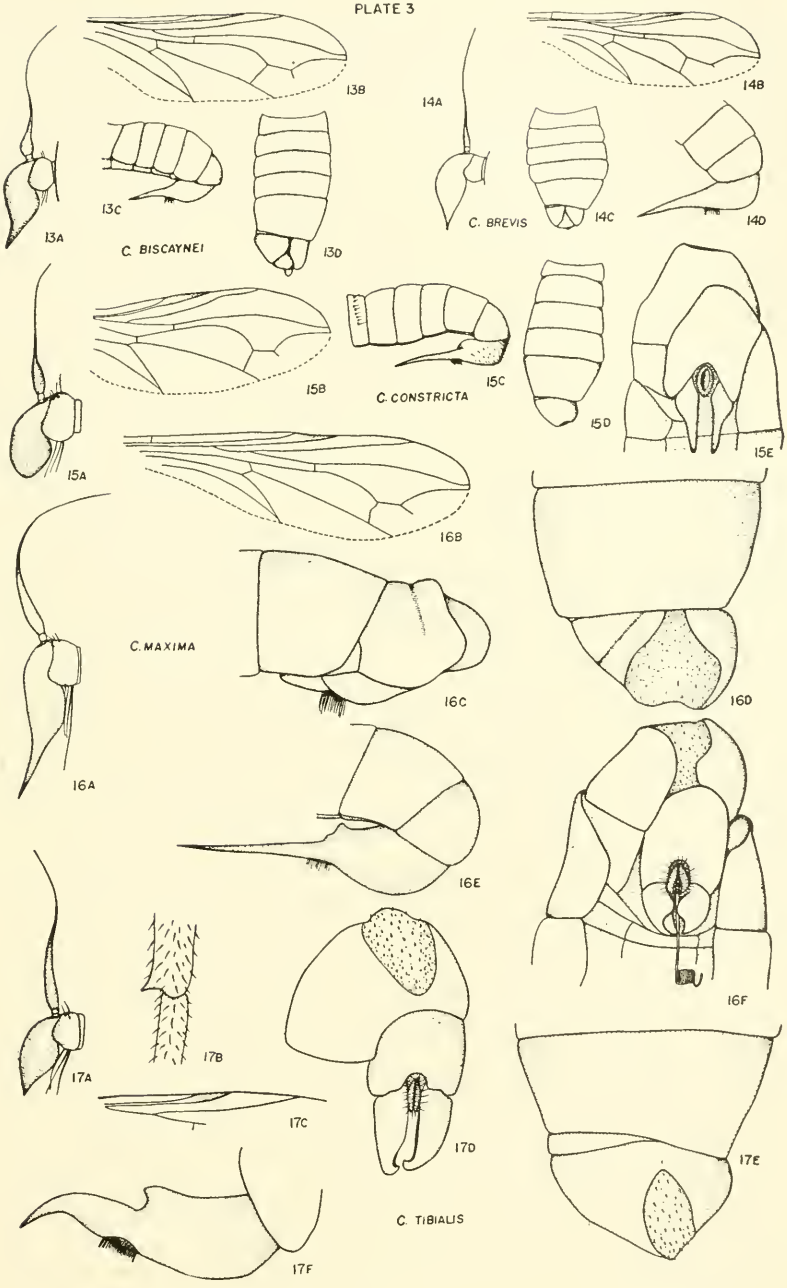

13A
13B
13C
13D
C. BISCAYNEI
14A
14B
14C
14D
C. BREVIS
15A
15B
15C
15D
15E
C. CONSTRICTA
16A
16B
16C
16D
16E
16F
C. MAXIMA
17A
17B
17C
17D
17E
17F
C. TIBIALIS

PLATE IV

FIG. 18. *C. stricklandi* (Curran). a. male hypopygium, dorsal.

FIG. 19. *Dorilas abberatus* (Hardy-Knowlton). a. antenna; b. wing; c. female abdomen, lateral.

FIG. 20. *D. aequus* (Cresson). a. antenna; b. male hypopygium, dorsal; c. hypopygium, lateral; d. female ovipositor, lateral; e. ovipositor, dorsal.

FIG. 21. *D. aequus* var. *argryofrons* (Hardy-Knowlton). a. male hapopygium, dorsal; b. male hypopygium, ventral; c. female ovipositor.

FIG. 22. *D. aequus* var. *longipes* (Hardy-Knowlton). a. female ovipositor.

FIG. 23. *D. affinis* (Cresson). a. antenna; b. wing; c. female ovipositor, lateral; d. ovipositor, dorsal; e. male hypopygium, dorsal; f. hypopygium, ventral.

FIG. 24. *D. alpinus* (Cresson). a. antenna; b. female abdomen, lateral.

FIG. 25. *D. alternatus* (Cresson). a. antenna, male; b. antenna, female; c. male hypopygium, dorsal.

FIG. 26. *D. angus* (Cresson). a. female ovipositor, lateral.

FIG. 27. *D. apicalis* (Hardy-Knowlton). a. antenna; b. wing, costal margin; c. male hypopygium, dorsal.

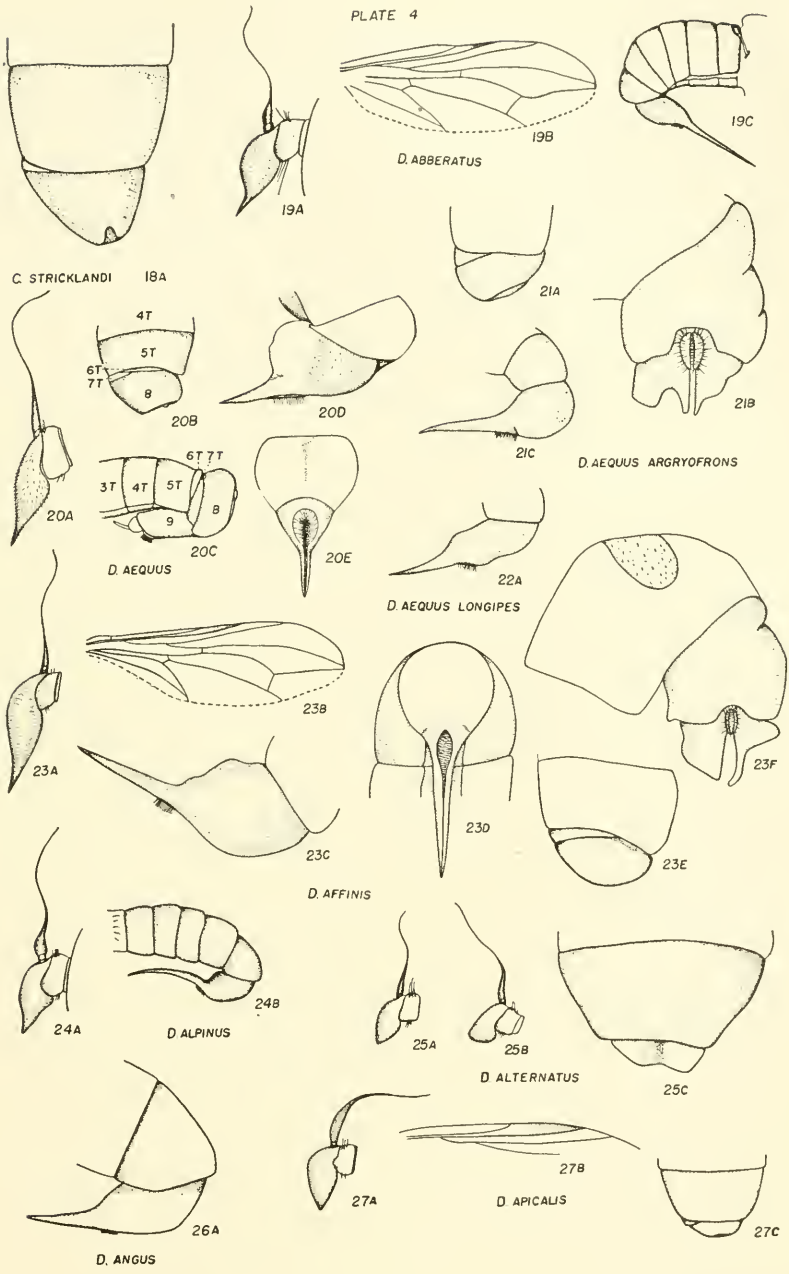


PLATE 4
19A
19B
D. ABBERATUS
19C
C. STRICKLANDI 18A
21A
21B
4T
5T
6T
7T
8
20B
20D
21C
D. AEQUUS ARGRYOFRONS
20A
6T 7T
3T
4T
5T
8
9
20C
D. AEQUUS
20E
22A
D. AEQUUS LONGIPES
23B
23A
23F
23C
23D
23E
D. AFFINIS
24A
24B
D. ALPINUS
25A
25B
D. ALTERNATUS
25C
26A
D. ANGUS
27A
27B
D. APICALIS
27C

PLATE V

FIG. 28. *D. aquavicinus* n. sp. a. antenna; b. male hypopygium, ventral; c. inner harpagone, lateral; d. female ovipositor, lateral; e. sixth sclerite of male; f. hypopygium, dorsal.

FIG. 29. *D. ater* (Meigen). a. antenna; b. wing; c. male hypopygium, ventral; d. hypopygium, dorsal; e. male abdomen, lateral; f. female abdomen, lateral.

FIG. 30. *D. atlanticus* (Hough). a. antenna; b. wing; c. female ovipositor, lateral; d. male abdomen, lateral; e. sixth sclerite of male; f. male abdomen, dorsal; g. female ovipositor, dorsal.

FIG. 31. *D. banksi* (Aczel). a. antenna; b. wing; c. female ovipositor, lateral; d. male abdomen, dorsal.

FIG. 32. *D. bidactylus* n. sp. a. antenna; b. male hypopygium, dorsal; c. male hypopygium, ventral.

FIG. 33. *D. caudatus* (Cresson). a. wing; b. male abdomen, dorsal view.

PLATE 5

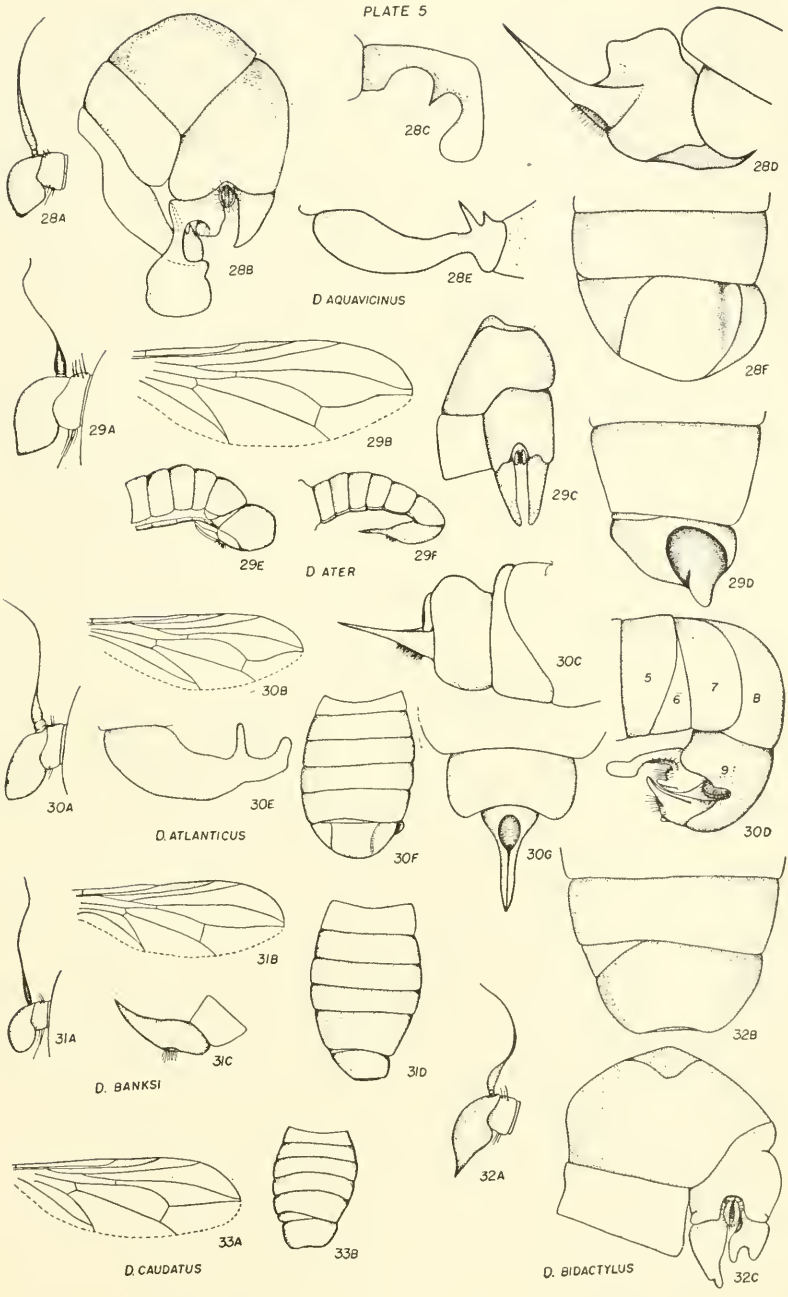

28A
28B
28C
28D
28E
D. AQUAVICINUS
28F
29A
29B
29C
29D
29E
29F
D. ATER
30A
30B
30C
30D
30E
D. ATLANTICUS
30F
30G
5
6
7
8
9
31A
31B
31C
31D
D. BANKSI
32A
32B
32C
D. BIDACTYLUS
33A
33B
D. CAUDATUS

PLATE VI

FIG. 33. *D. caudatus* (Cresson). c. male hypopygium, ventral.

FIG. 34. *D. caudatus* var. *discolor* (Banks). a. antenna; b. female ovipositor, lateral.

FIG. 35. *D. cinctus* (Banks). a. antenna; b. wing; c. male hypopygium, ventral; d. hypopygium, dorsal.

FIG. 36. *D. cinctus subtilis* n. sub. sp. a. male hypopygium, ventral; b. female ovipositor, lateral.

FIG. 37. *D. curtus* n. sp. a. antenna; b. costal margin of wing; c. male hypopygium, lateral; d. hypopygium, dorsal; e. hypopygium, ventral.

FIG. 38. *D. fuscitarsus* (Adams). a. antenna; b. wing; c. male hypopygium, dorsal.

FIG. 39. *D. fuscus* (Loew). a. antenna; b. wing; c. male hypopygium, ventral; d. hypopygium, dorsal.

FIG. 40. *D. fuscus* var. *nitidiventris* (Loew). a. female ovipositor, lateral; b. male hypopygium, dorsal; c. hypopygium, ventral.

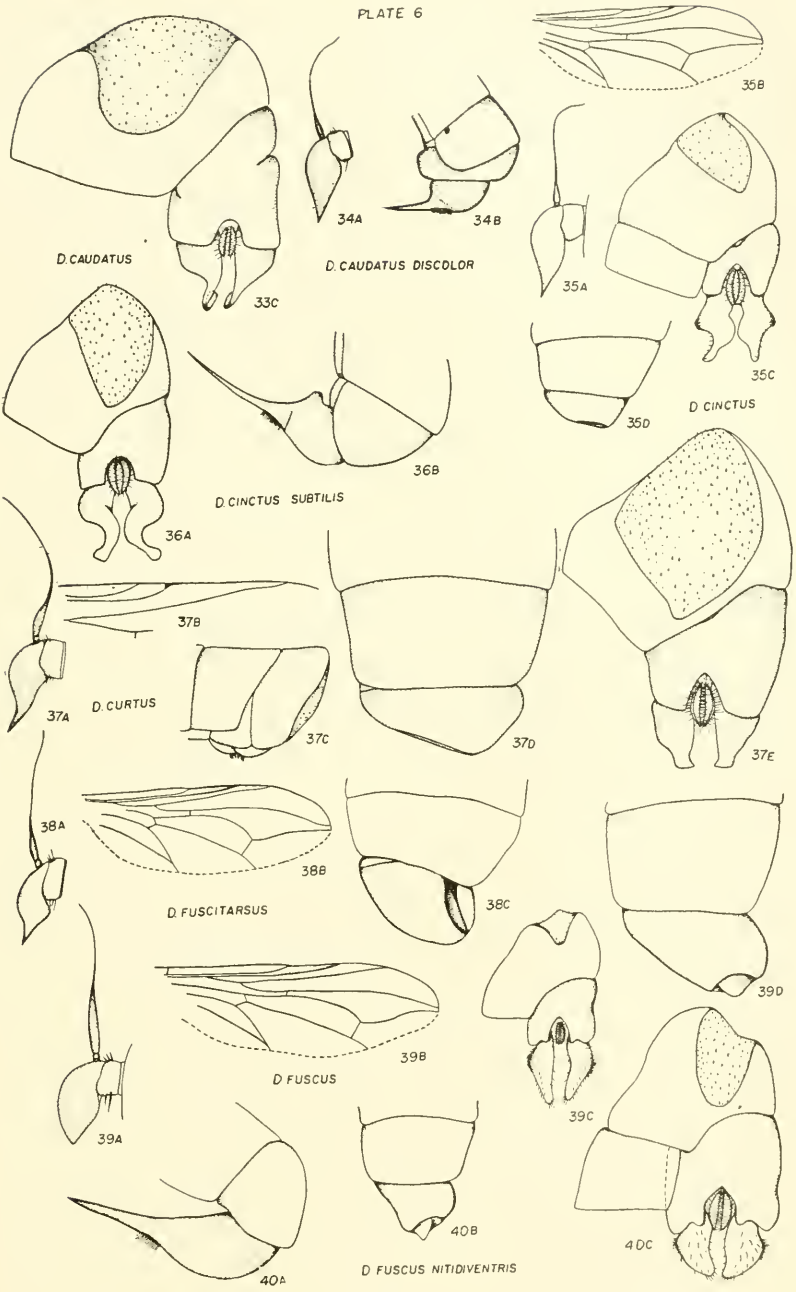


PLATE 6
D. CAUDATUS
33C
34A
34B
D. CAUDATUS DISCOLOR
35B
35A
35C
35D
D. CINCTUS
36A
D. CINCTUS SUBTILIS
36B
37A
D. CURTUS
37B
37C
37D
37E
38A
38B
D. FUSCITARSUS
38C
39A
D. FUSCUS
39B
39C
39D
40A
40B
D. FUSCUS NITIDIVENTRIS
40C

PLATE VII

FIG. 41. *D. grandis* n. sp. a. antenna; b. wing; c. male hypopygium, lateral; d. hypopygium, ventral; e. hypopygium, dorsal; f. female ovipositor, lateral.

FIG. 42. *D. harmstoni* (Hardy-Knowlton). a. antenna; b. male hypopygium, dorsal.

FIG. 43. *D. houghii* (Kertesz). a. antenna; b. wing; c. female ovipositor, lateral; d. male abdomen, dorsal.

FIG. 44. *D. houghii apicarinus* (Hardy-Knowlton). a. costal margin of wing; b. male hypopygium, dorsal.

FIG. 45. *D. huachucanus* n. sp. a. antenna; b. male hypopygium, dorsal; c. inner harpagone, extended; d. female ovipositor, lateral; e. ovipositor, dorsal; f. male hypopygium, lateral; g. hypopygium, ventral.

FIG. 46. *D. kansensis* Hardy. a. wing, costal margin, b. male hypopygium, dorsal.

FIG. 47. *D. lasiofemoratus* (Hardy-Knowlton). a. antenna; b. costal margin of wing; c. male hypopygium, dorsal.

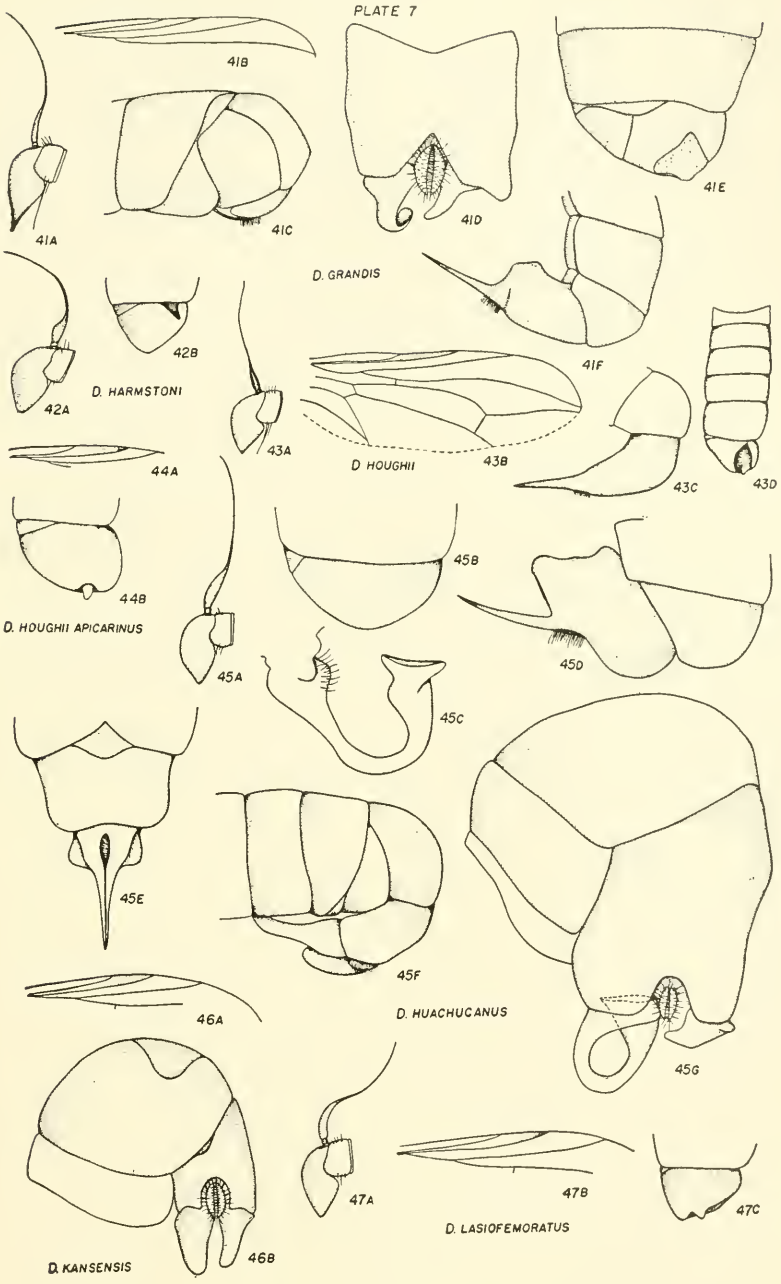


PLATE 7
41B
41A
41C
41D
41E
D. GRANDIS
41F
42B
42A
D. HARMSTONI
43A
D HOUGHII
43B
43C
43D
44A
44B
D. HOUGHII APICARINUS
45A
45B
45C
45D
45E
45F
D. HUACHUCANUS
45G
46A
D. KANSENSIS
46B
47A
47B
D. LASIOFEMORATUS
47C

PLATE VIII

FIG. 48. *D. latipennis* (Banks). a. antenna; b. wing; c. female ovipositor, lateral.

FIG. 49. *D. lautus* n. sp. a. antenna; b. female ovipositor and posterior segments of abdomen, lateral; c. ovipositor, dorsal; d. male hypopygium, ventral; e. hypopygium, dorsal.

FIG. 50. *D. locwii* (Kertesz). a. abdomen of female, lateral; b. male hypopygium, ventral; c. antenna; d. wing; e. male abdomen, dorsal.

FIG. 51. *D. luteicornis* (Cresson). a. antenna; b. wing; c. female abdomen, lateral view.

FIG. 52. *D. minor* (Cresson). a. antenna; b. wing; c. female abdomen, lateral; d. female ovipositor, dorsal; e. male abdomen, dorsal; f. hypopygium, lateral.

FIG. 53. *D. montivagus* n. sp. a. antenna; b. wing; c. male hypopygium, ventral; d. hypopygium, dorsal; e. female ovipositor, lateral.

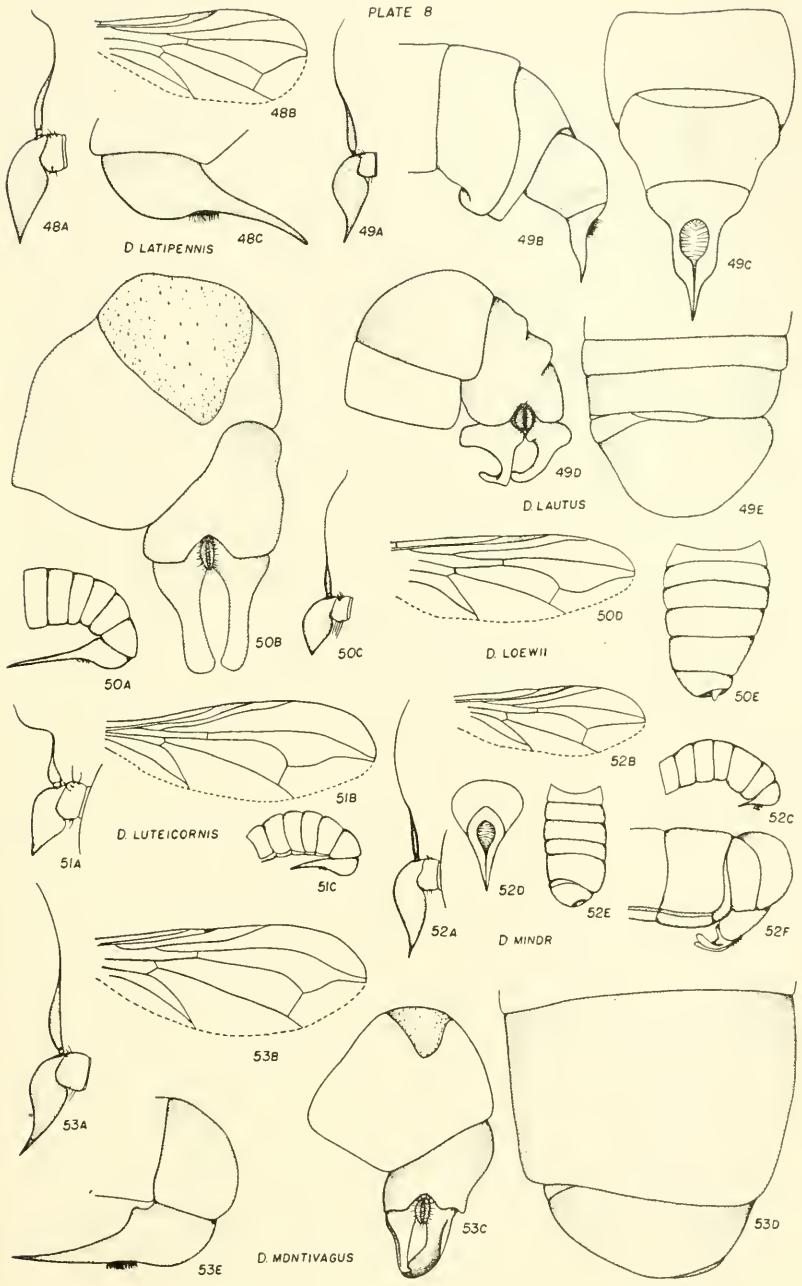


PLATE 8
48A
48B
48C
D. LATIPENNIS
49A
49B
49C
49D
D. LAUTUS
49E
50A
50B
50C
50D
D. LOEWII
50E
51A
51B
51C
D. LUTEICORNIS
52A
52B
52C
52D
52E
52F
D. MINDR
53A
53B
53C
53D
53E
D. MONTIVAGUS

PLATE IX

FIG. 54. *D. nevadaensis* n. sp. a. antennae; b. female ovipositor, lateral; c. wing; d. male hypopygium, dorsal; e. hypopygium, lateral; f. hypopygium, ventral.

FIG. 55. *D. nigripes* (Loew). a. antenna; b. male hypopygium, dorsal; c. female abdomen, lateral; d. wing.

FIG. 56. *D. pallipes* (Johnson). a. antenna; b. wing; c. female ovipositor, lateral; d. ovipositor, dorsal, e. male hypopygium, dorsal; f. hypopygium, ventral.

FIG. 57. *D. reipublicae* (Walker). a. antenna; b. wing; c. female ovipositor, lateral; d. male hypopygium, lateral; e. abdomen, dorsal.

FIG. 58. *D. sabroskyi* n. sp. a. antenna; b. wing; c. female ovipositor, lateral; d. ovipositor, dorsal; e. male hypopygium, dorsal; f. hypopygium, ventral.

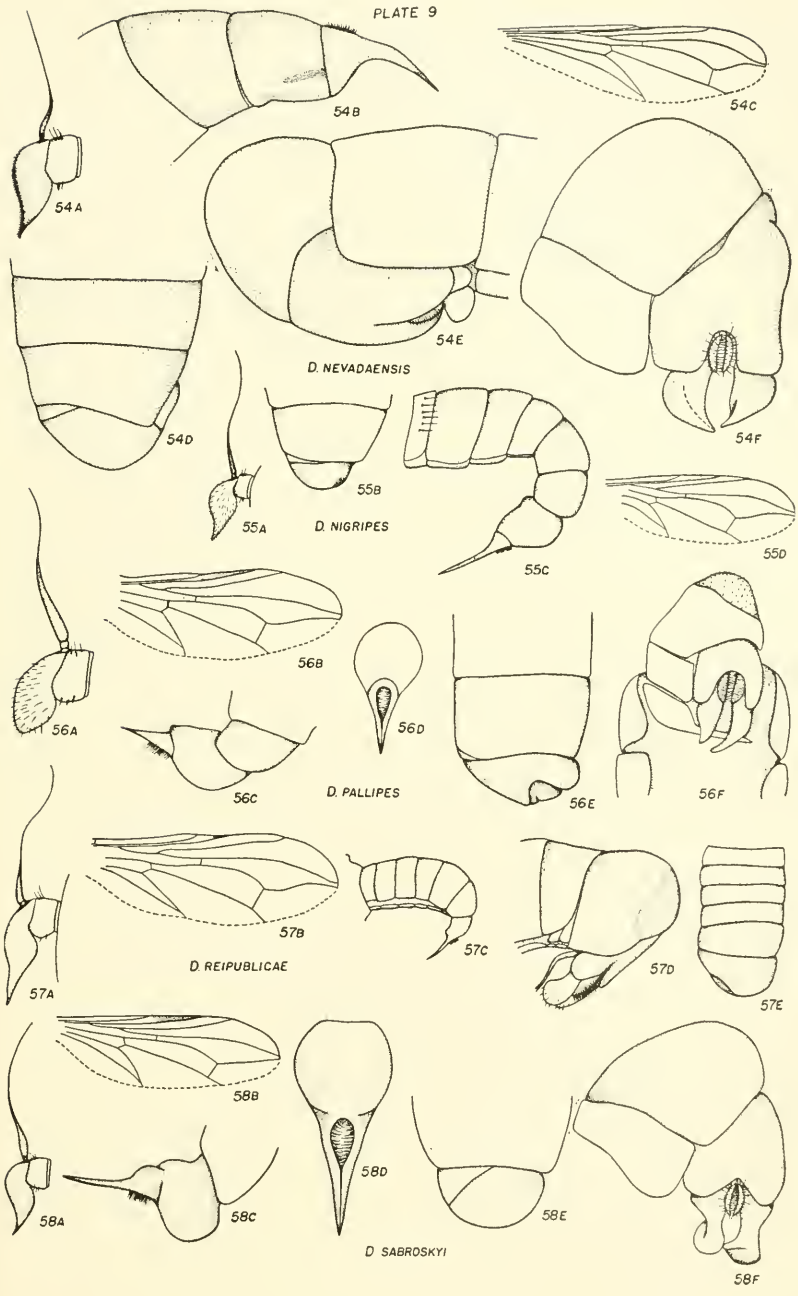


PLATE 9
54A
54B
54C
54D
54E
D. NEVADAENSIS
54F
55A
55B
D. NIGRIPES
55C
55D
56A
56B
56C
56D
D. PALLIPES
56E
56F
57A
57B
D. REIPUBLICAE
57C
57D
57E
58A
58B
58C
58D
D. SABROSKYI
58E
58F

PLATE X

FIG. 59. *D. stainsi* n. sp. a. antenna; b. male hypopygium, ventral; c. hypopygium, dorsal.

FIG. 60. *D. stigmaticus* (Malloch). a. antenna; b. costal margin of wing, male; c. wing, female; d. male hypopygium, dorsal view.

FIG. 61. *D. stigmaticus brachystigmaticus* (Hardy-Knowlton). a. antenna; b. male abdomen, dorsal; c. female ovipositor, lateral; d. ovipositor, dorsal; e. male hypopygium, ventral; f. wing; g. hypopygium, lateral.

FIG. 62. *D. subopacus* (Loew). a. antenna; b. posterior portion of female abdomen, ventral; c. male abdomen, dorsal; d. wing; e. male hypopygium, ventral.

FIG. 63. *D. subopacus industrius* (Knab). a. female ovipositor, lateral.

FIG. 64. *D. tarsalis* (Banks). a. antenna; b. wing; c. ninth segment and harpagones, ventral; d. male abdomen, dorsal.

PLATE 10

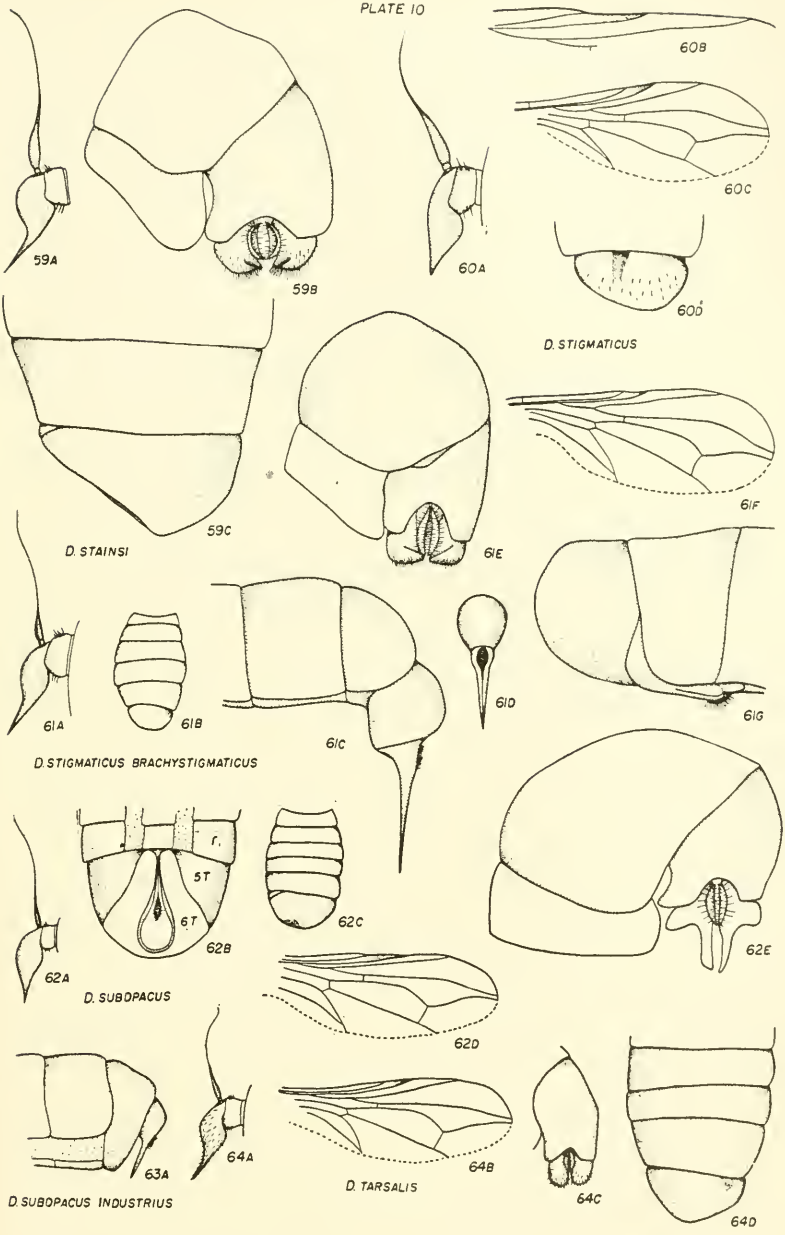

59A
59B
60A
60B
60C
60D
D. STIGMATICUS
59C
D. STAINSI
61E
61F
61A
61B
61C
61D
61G
D. STIGMATICUS BRACHYSTIGMATICUS
r.
5T
6T
62A
62B
62C
62E
D. SUBOPACUS
62D
63A
64A
D. SUBOPACUS INDUSTRIUS
64B
D. TARSALIS
64C
64D

PLATE XI

FIG. 65. *D. trichaetus* (Malloch). a. antenna; b. wing; c. female ovipositor, dorsal; d. ovipositor, lateral.

FIG. 66. *D. varius* (Cresson). a. antenna; b. ovipositor, lateral; c. male hypopygium, dorsal; d. hypopygium, ventral; e. wing; f. male abdomen, lateral.

FIG. 67. *D. vierecki* (Malloch). a. antenna; b. male hypopygium, lateral; c. ovipositor, lateral; d. wing; e. hypopygium, dorsal; f. hypopygium, ventral.

FIG. 68. *Allomethus brimleyi* n. sp. a. antenna; b. wing; c. male abdomen, dorsal.

FIG. 69. A. *flavicornis* (Williston). a. wing.

FIG. 70. A. *xanthopodus* (Williston). a. wing.

FIG. 71. *Dorylomorpha atramontensis* (Banks). a. male hypopygium, dorsal; b. antenna.

PLATE II

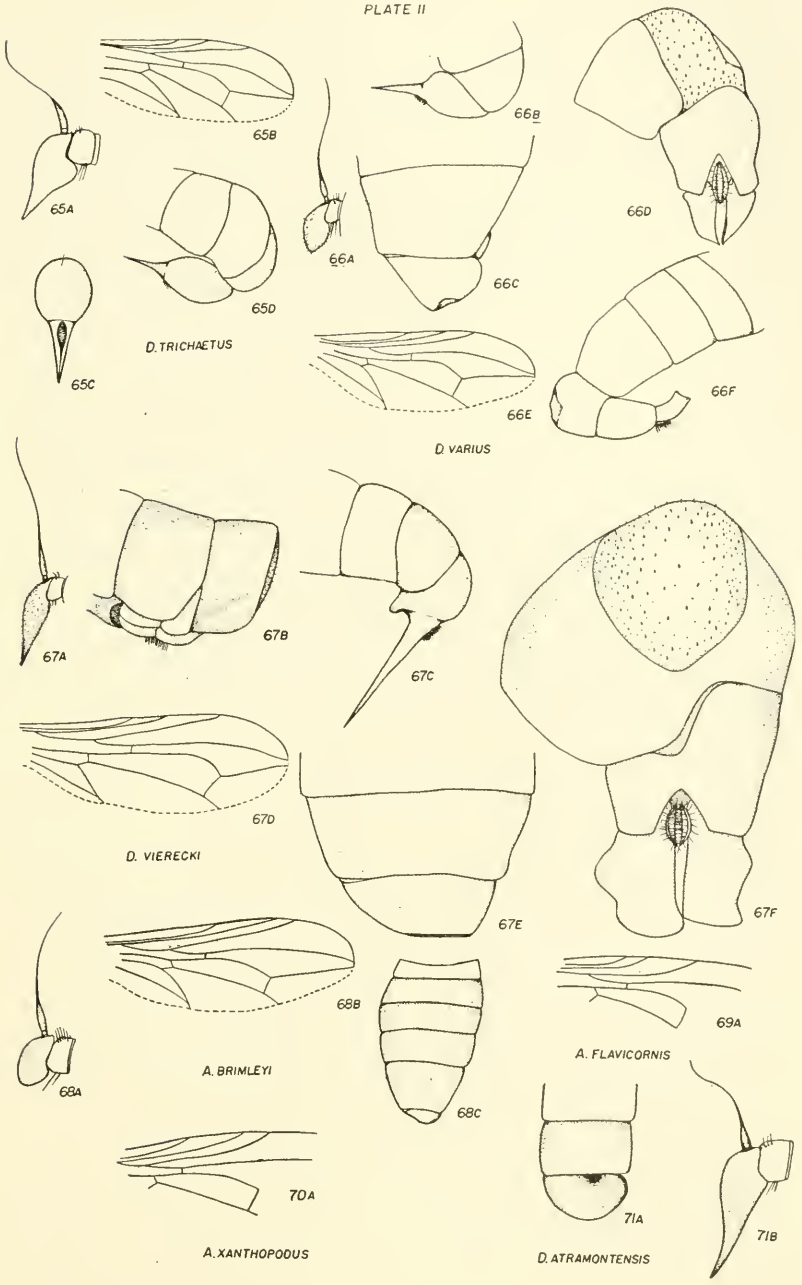

65A
65B
65C
65D
D. TRICHAETUS
66A
66B
66C
66D
66E
66F
D. VARIUS
67A
67B
67C
67D
D. VIERECKI
67E
67F
68A
68B
A. BRIMLEYI
68C
69A
A. FLAVICORNIS
70A
A. XANTHOPODUS
71A
71B
D. ATRAMONTENSIS

PLATE XII

FIG. 72. *D. canadensis* n. sp. a. antenna; b. sixth and seventh sclerites of male abdomen; c. female ovipositor, dorsal; d. male hypopygium, ventral; e. hypopygium, dorsal; f. ovipositor, lateral.

FIG. 73. *D. caudelli* (Malloch). a. antenna; b. female ovipositor, dorsal; c. male hypopygium, ventral; d. costal margin of wing; e. ovipositor, lateral; f. hypopygium, dorsal; g. male abdomen, lateral.

FIG. 74. *D. exilis* (Malloch). a. antenna; b. female ovipositor, lateral; c. wing; d. male abdomen, dorsal; e. hypopygium, ventral.

FIG. 75. *D. flavomaculata* (Hough). a. antenna; b. wing; c. female abdomen, lateral; d. male hypopygium, ventral; e. hypopygium, dorsal; f. male abdomen, lateral.

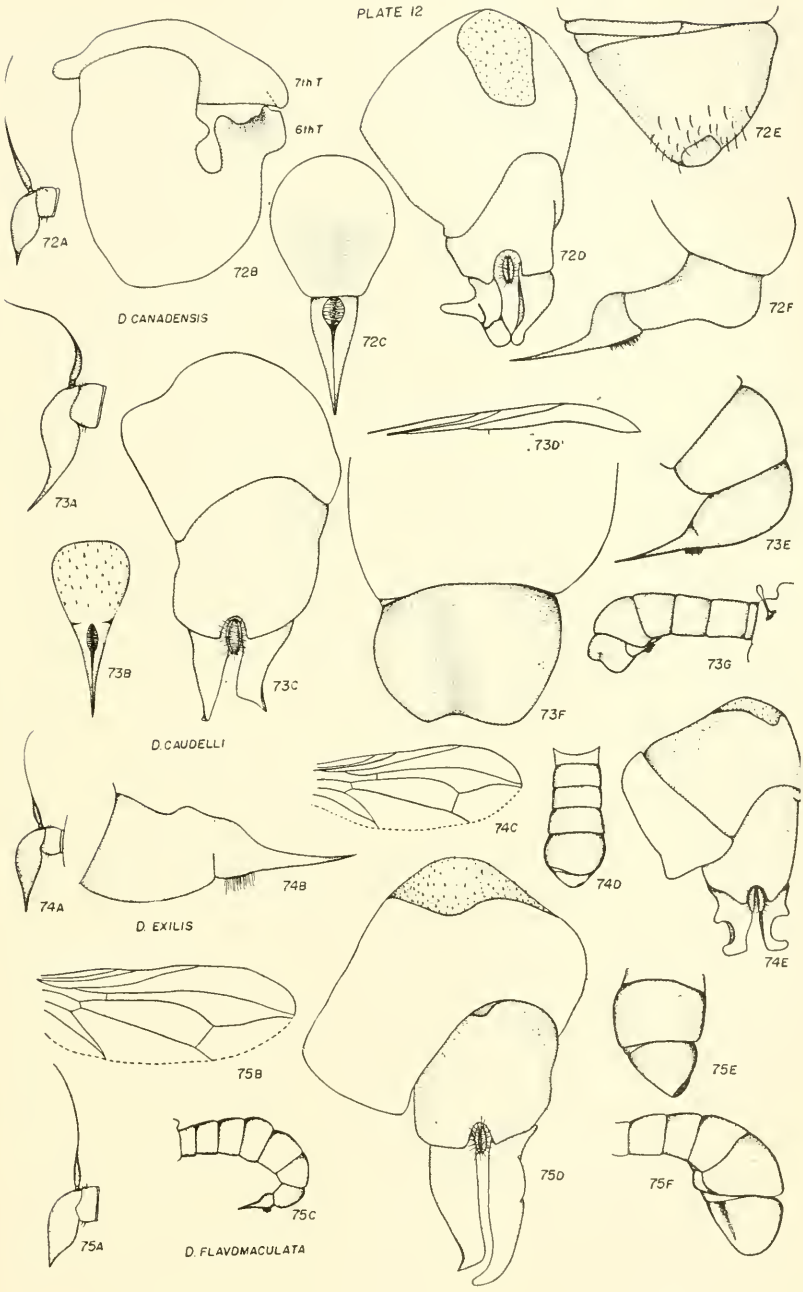


PLATE 12
7thT
6thT
72A
72B
D. CANADENSIS
72C
72D
72E
72F
73A
73B
73C
D. CAUDELLI
73D
73E
73F
73G
74A
74B
D. EXILIS
74C
74D
74E
75A
75B
75C
D. FLAVOMACULATA
75D
75E
75F

PLATE XIII

FIG. 76. *D. occidens* (Hardy). a. antenna; b. wing; c. male hypopygium, dorsal; d. male abdomen, lateral; e. hypopygium, ventral.

FIG. 77. *D. ornata* n. sp. a. antenna; b. male hypopygium, ventral; c. sixth and seventh sclerites of male abdomen; d. inner harpagone, lateral; e. outer harpagone, lateral; f. female ovipositor, lateral.

FIG. 78. *D. tridentata* n. sp. a. antenna; b. wing; c. male abdomen, lateral; d. hypopygium, ventral; e. female ovipositor, dorsal; f. hypopygium, dorsal; g. sixth and seventh sclerites of male; h. ovipositor, lateral.

FIG. 79. *D. uncinata* n. sp. a. female antenna; b. apex of female wing; c. wing of male; d. female abdomen, lateral.

PLATE 13

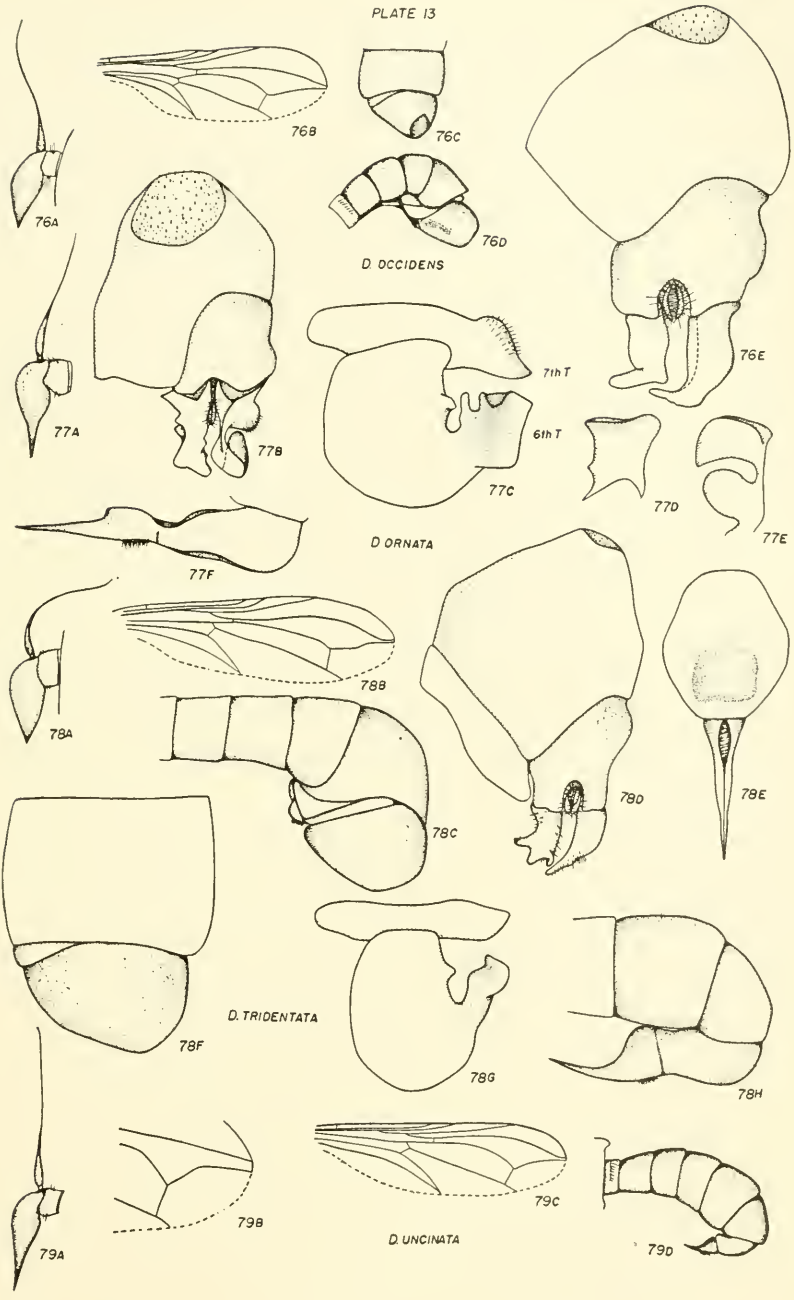

76A
76B
76C
76D
D. OCCIDENS
76E
77A
77B
7thT
6thT
77C
77D
77E
77F
D. ORNATA
78A
78B
78C
78D
78E
78F
D. TRIDENTATA
78G
78H
79A
79B
79C
D. UNCINATA
79D

PLATE XIV

FIG. 79. *D. uncinata* n. sp. e. hypopygium dorsal; f. male antenna; g. hypopygium ventral.

FIG. 80. *Tömösváryella agnesea* Hardy. a. front of male; b. male hypopygium, ventral; c. hypopygium, lateral.

FIG. 81. *T. appendipes* (Cresson). a. antenna; b. hind leg of male; c. wing; d. variation of hind trochanter of male; e. male hypopygium, ventral; f. hypopygium, dorsal; g. female abdomen, lateral; h. variation in hind trochanter of male.

FIG. 82. *T. armata* Hardy. a. male hypopygium, ventral; b. posterior trochanter of male.

FIG. 83. *T. beameri* Hardy. a. posterior trochanter of male; b. male hypopygium, ventral.

FIG. 84. *T. bidens* (Cresson). a. antenna; b. wing; c. posterior trochanter of male; d. male hypopygium, dorsal; e. female abdomen, lateral; f. hypopygium, ventral.

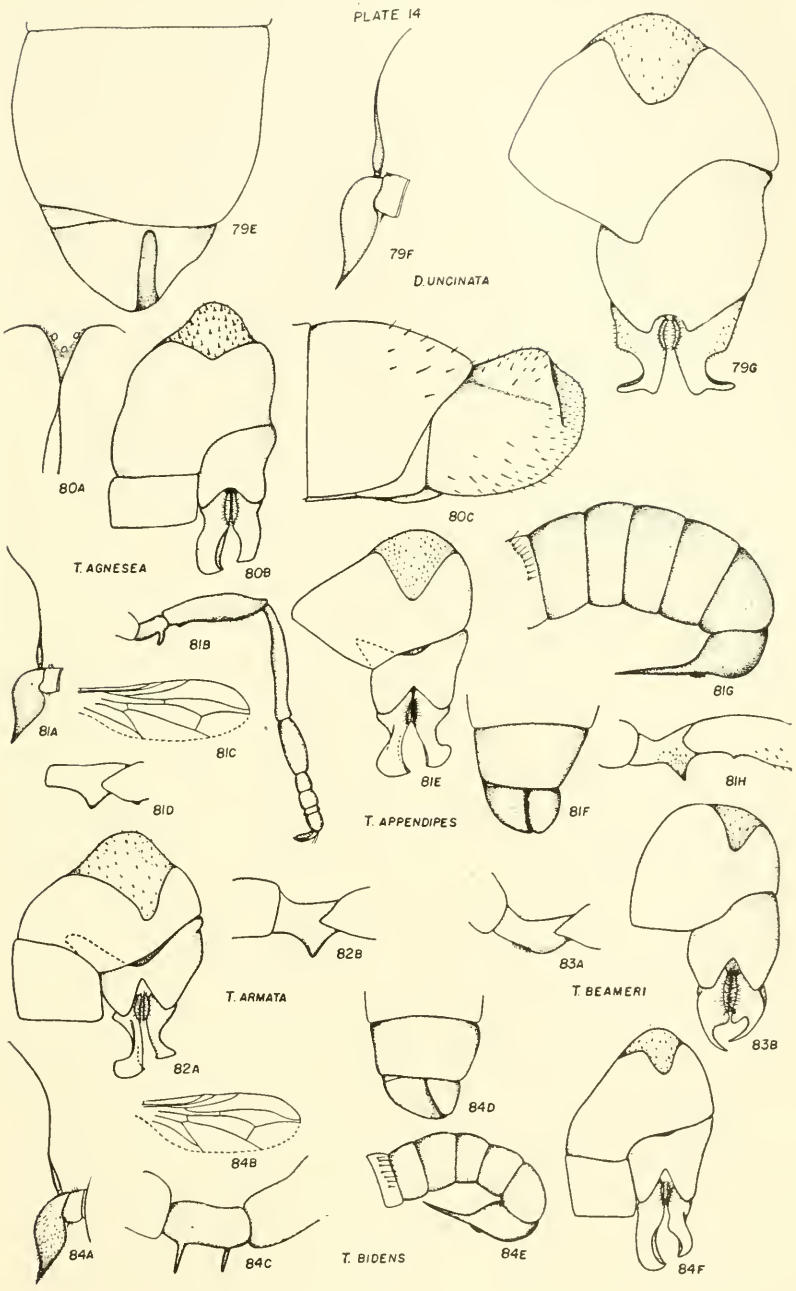


PLATE 14
79E
79F
D. UNCINATA
79G
80A
80B
T. AGNESEA
80C
81A
81B
81C
81D
81E
T. APPENDIPES
81F
81G
81H
82A
T. ARMATA
82B
83A
T. BEAMERI
83B
84A
84B
84C
T. BIDENS
84D
84E
84F

PLATE XV

FIG. 85. *T. brevijuncta* n. sp. a. antenna; b. female abdomen, lateral; c. male hypopygium, dorsal; d. hypopygium, ventral; e. posterior trochanter of male; f. posterior trochanter of female.

FIG. 86. *T. columbiana* (Kertesz). a. antenna; b. hind leg of male; c. male hypopygium, lateral; d. hypopygium, dorsal.

FIG. 87. *T. contorta* (Hardy). a. antenna; b. posterior leg of female; c. posterior leg of male; d. male abdomen, dorsal; e. female abdomen, lateral; f. male hypopygium, lateral; g. hypopygium, ventral.

FIG. 88. *T. coquilletti* (Kertesz). a. antenna; b. wing; c. male hypopygium, right lateral; d. posterior trochanter of male; e. female abdomen, lateral; f. male hypopygium, ventral; g. hypopygium, dorsal.

FIG. 89. *T. dissimilis* n. sp. a. posterior trochanter of male; b. female ovipositor, lateral view.

PLATE 15

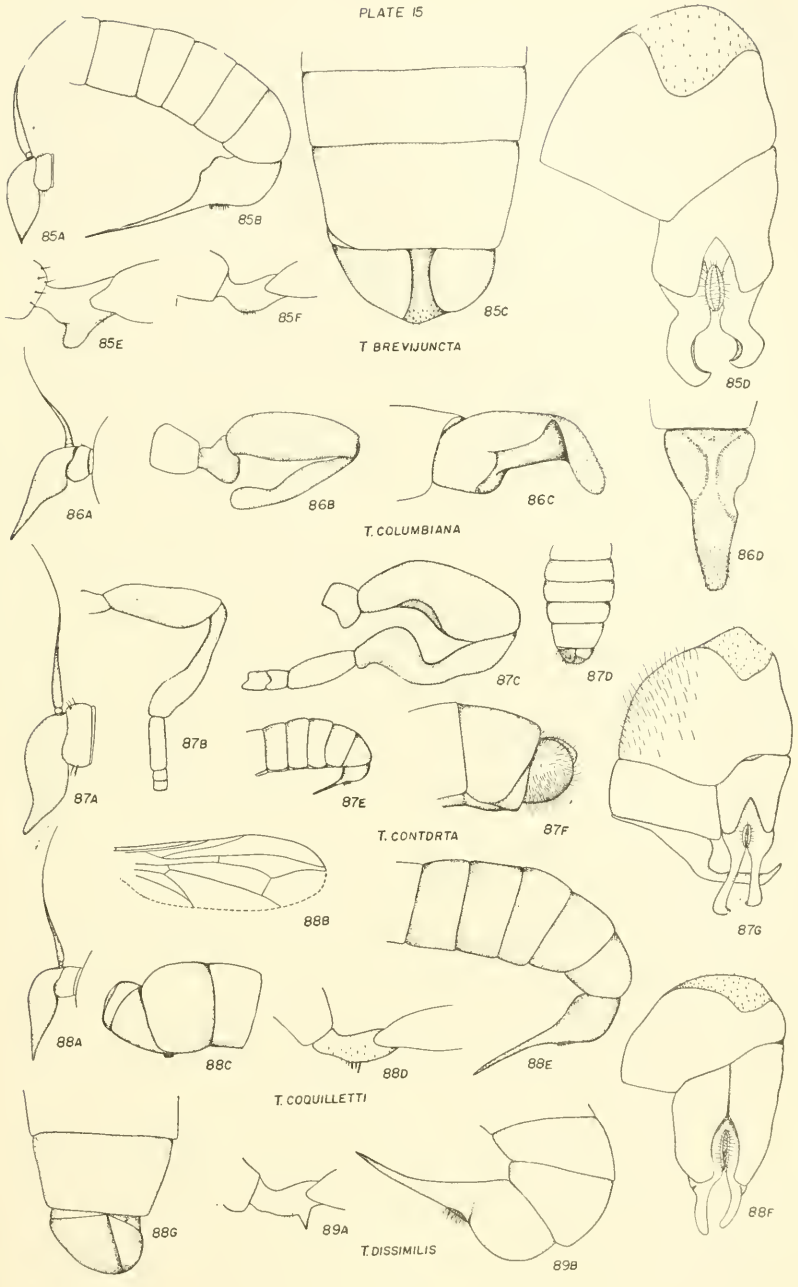

85A
85B
85C
85D
85E
85F
T. BREVIJUNCTA
86A
86B
86C
86D
T. COLUMBIANA
87A
87B
87C
87D
87E
87F
T. CONTORTA
87G
88A
88B
88C
88D
88E
T. COQUILLETTI
88F
88G
89A
89B
T. DISSIMILIS

PLATE XVI

FIG. 89. *T. dissimilis* n. sp. c. antenna; d. male hypopygium, ventral; e. hypopygium, dorsal.

FIG. 90. *T. exilidens* n. sp. a. male hypopygium, dorsal, b. hypopygium, ventral; c. female ovipositor, lateral; d. posterior trochanter of male.

FIG. 91. *T. floridensis* (Hardy). a. posterior trochanter of male; b. male hypopygium, dorsal; c. hypopygium, ventral.

FIG. 92. *T. lepidipes* n. sp. a. antenna; b. male hypopygium, dorsal; c. hypopygium, ventral; d. female ovipositor, lateral; e. posterior trochanter of male.

FIG. 93. *T. minacis* Hardy. a. posterior trochanter of male; b. lateral view of outer harpagone; c. harpagones, ventral.

FIG. 94. *T. pauca* n. sp. a. posterior trochanter of male; b. male hypopygium, ventral.

FIG. 95. *T. propinqua* n. sp. a. male hypopygium, dorsal; b. hypopygium, ventral; c. female ovipositor, dorsal; d. posterior trochanter of male.

FIG. 96. *T. quadradentis* n. sp. a. male hypopygium, ventral; b. hypopygium, dorsal.

PLATE 16

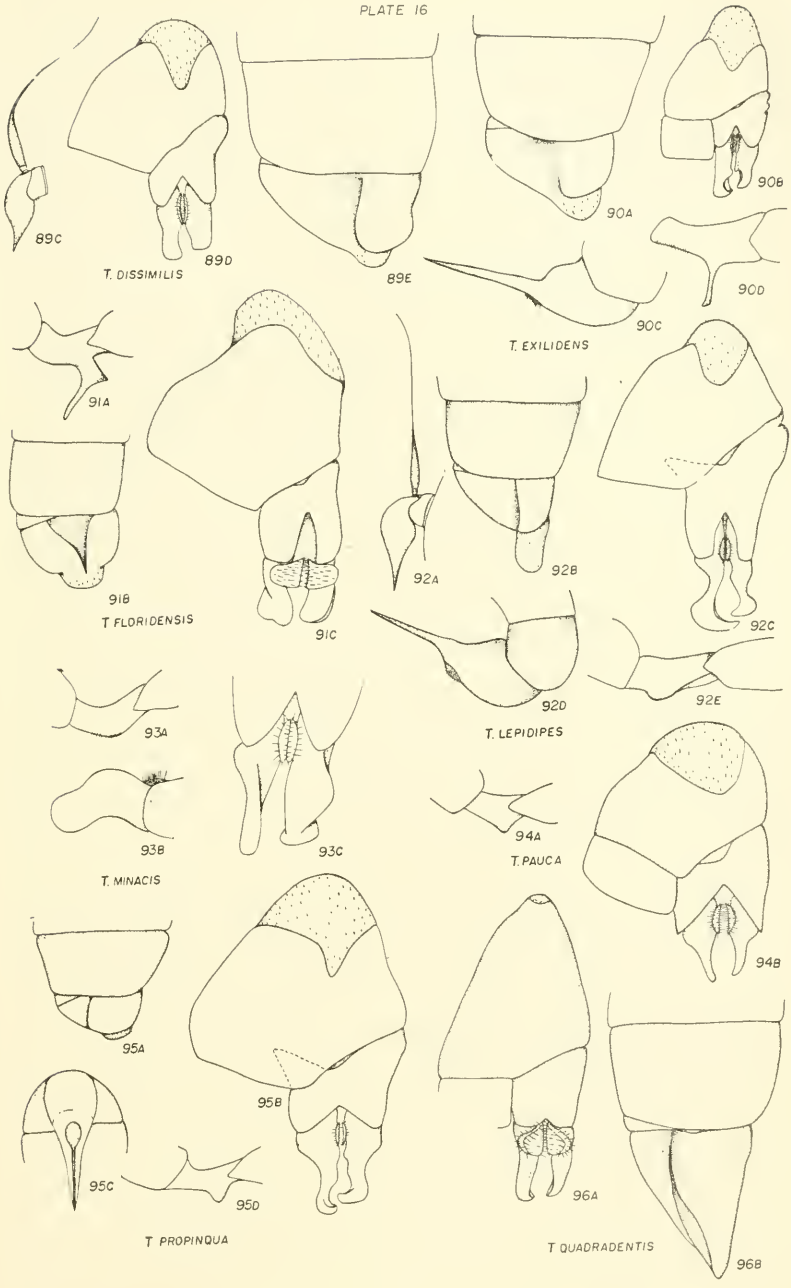

89C
89D
T. DISSIMILIS
89E
90A
90B
90C
90D
T. EXILIDENS
91A
91B
T. FLORIDENSIS
91C
92A
92B
92C
92D
92E
T. LEPIDIPES
93A
93B
T. MINACIS
93C
94A
T. PAUCA
94B
95A
95B
95C
95D
T. PROPINQUA
96A
T. QUADRADENTIS
96B

PLATE XVII

FIG. 96. *T. quadradentis* n. sp. c. antenna; d. posterior trochanter of male.

FIG. 97. *T. sachtlebeni* (Aczel). a. antenna; b. wing; c. posterior trochanter of male; d. abdomen of male, dorsal; e. hypopygium, ventral.

FIG. 98. *T. similis* (Hough). a. antenna; b. hypopygium, lateral; c. hypopygium, right lateral with abdomen dissected away; d. hypopygium, ventral; e. abdomen of male, dorsal; f. posterior trochanter of male; g. female ovipositor, lateral; h. front of male.

FIG. 99. *T. sonorensis* (Cole). a. posterior trochanter of male, copied from Cole's fig.

FIG. 100. *T. subnitens* (Cresson). a. antenna; b. male hypopygium, dorsal; c. posterior trochanter of male; d. variation in posterior trochanter of male; e. wing; f. female ovipositor, lateral; g. hypopygium, ventral.

FIG. 101. *T. subvirescens* (Loew). a. posterior trochanter of male; b. male hypopygium, dorsal; c. outer harpagone, lateral; d. inner harpagone, lateral; e. hypopygium, ventral.

FIG. 102. *T. sylvatica* (Meigen). a. antenna; b. male abdomen, lateral; c. posterior trochanter of male; d. hypopygium, dorsal; e. hypopygium, ventral; f. male and female in copula.

PLATE 17

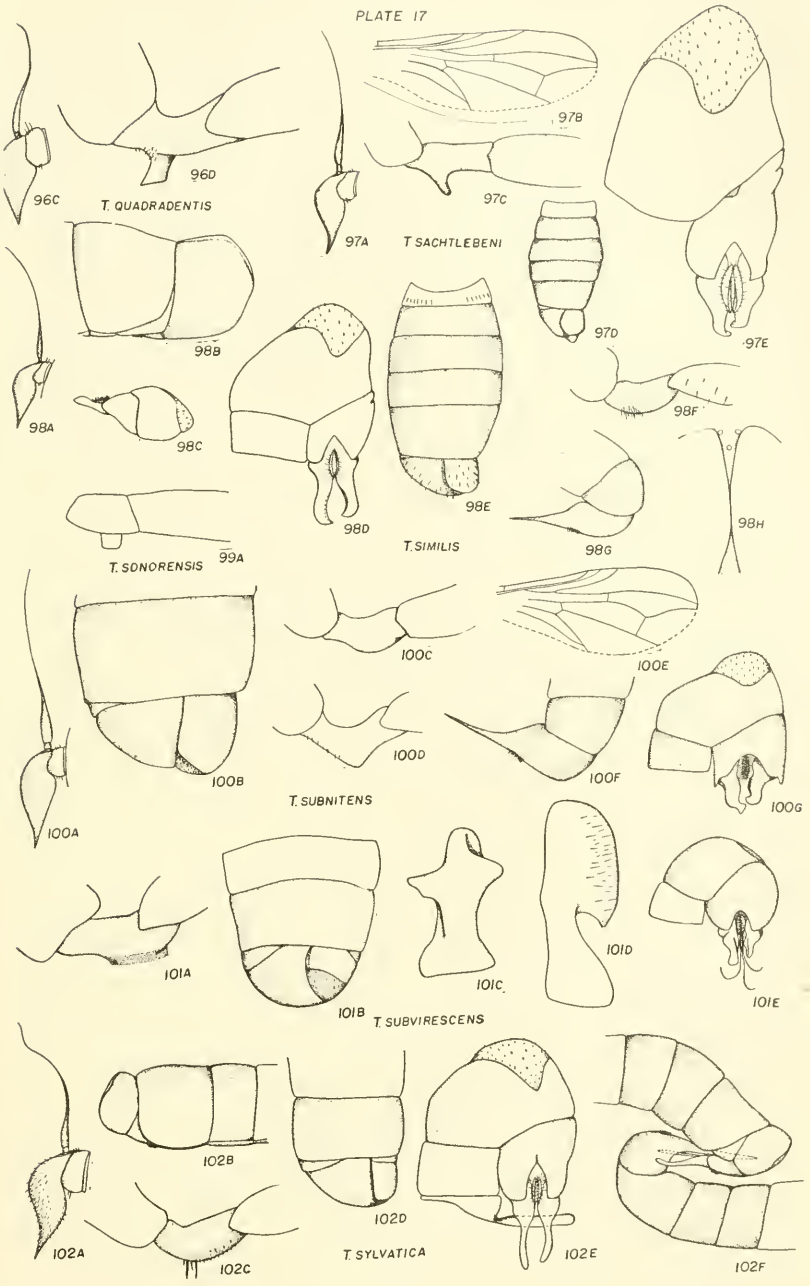

96C
96D
T. QUADRADENTIS
97A
T. SACHTLEBENI
97B
97C
97D
97E
98A
98B
98C
98D
98E
T. SIMILIS
98F
98G
98H
99A
T. SONORENSIS
100A
100B
T. SUBNITENS
100C
100D
100E
100F
100G
101A
101B
T. SUBVIRESCENS
101C
101D
101E
102A
102B
102C
T. SYLVATICA
102D
102E
102F

PLATE XVIII

FIG. 103. *T. toxodontis* (Hardy-Knowlton). a. male hypopygium, dorsal; b. posterior trochanter of male.

FIG. 104. *T. tumida* Hardy. a. posterior trochanter of male; b. hypopygium; dorsal; c. hypopygium, ventral.

FIG. 105. *T. turgida* Hardy. a. male hypopygium, dorsal; b. posterior trochanter of male; c. hypopygium, ventral.

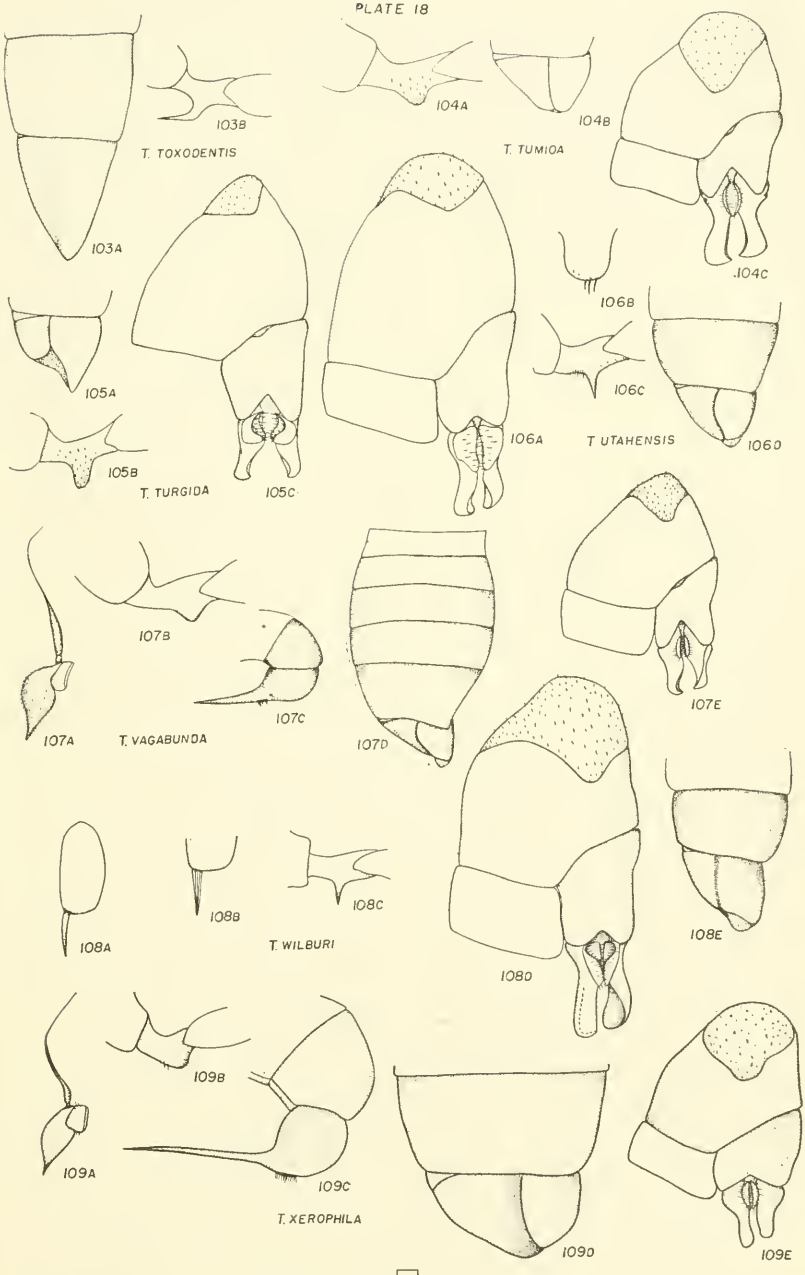
FIG. 106. *T. utahensis* (Hardy-Knowlton). a. male hypopygium, ventral; b. middle coxa of male, dorsal; c. posterior trochanter of male; d. hypopygium, dorsal.

FIG. 107. *T. vagabunda* (Knab). a. antenna; b. posterior trochanter of male; c. female ovipositor, lateral; d. male abdomen, dorsal; e. hypopygium, ventral.

FIG. 108. *T. wilburi* (Hardy). a. middle coxa of male, lateral; b. mid-coxa, dorsal; c. posterior trochanter of male; d. male hypopygium, ventral; e. hypopygium, dorsal.

FIG. 109. *T. xerophila* n. sp. a. antenna; b. posterior tronchanter of male; c. female ovipositor, lateral; d. male hypopygium, dorsal; e. hypopygium, ventral.

PLATE 18



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XXII.....Nos. 1-18, weight, 32 ounces.

XXIII.....No. 1, weight, 40 ounces.

XXIV.....Nos. 1-21, weight, 38 ounces.

XXV.....Nos. 1-22, weight, 43 ounces.

XXVI.....Nos. 1-15, weight, 40 ounces.

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University of Kansas Science Bulletin - Vol. XXIX - Part II
October 15, 1943
Lawrence, Kansas

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Pt. II—Nov. 12, 1942.
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VOLUME XXIX, PART II

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THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

VOL. XXIX, pt. II.] OCTOBER 15, 1943 [No. 2

The Rezabek Fauna, a New Pleistocene Fauna from Lincoln County, Kansas

CLAUDE W. HIBBARD,
Museum of Vertebrate Paleontology, University of Kansas

ABSTRACT: A new Pleistocene mammalian assemblage is described from Lincoln county, Kansas. The mammals were found associated with other vertebrates and numerous invertebrates, which are known as the Rezabek fauna. The deposit from which the fauna was recovered is younger than the Meade formation into which it is channeled. The paper treats of the Mammalia, which are represented by 5 orders, 8 families, 15 genera, and 9 species, of which the following are described as new: *Blarina fossilis* sp. nov.; *Neofiber leonardi* sp. nov. With text figures.

INTRODUCTION

IN THE summer of 1941, Doctor John C. Frye, State Geologist, of the Kansas State Geological Survey, was engaged in a study of the ground-water resources of parts of Russell and Ellis counties, Kansas. During this study Frye located a number of fossil localities in the area under study. That fall Doctor A. B. Leonard and I visited the area and worked with him on the fossil localities. These were reported in a paper by Frye, Leonard and Hibbard (1943).

In the summer of 1942, the excess rains in Clark county delayed our work in that area because we were unable to travel the unimproved roads and trails. Advantage was taken of such conditions to haul a load of matrix from the Rezabek gravel pit to our camp. This matrix was subsequently washed out, and the fossils recovered form the basis of this paper.

Acknowledgment is made of the kindness of Mr. Frank Rezabek, who has given us the matrix for study and donated the horse tooth which he had taken from the exposure; to Mr. Lee Larrabee, chairman, and Mr. Guy D. Josserand, Director, of the Kansas State

Fish and Game Commission, Mr. Leonard Sutherland of the Meade County State Park for camping and washing facilities and other courtesies shown our party; to Mr. C. D. Bunker, Curator of Museum of Modern Vertebrates, Kansas University, for the loan of recent material for study; and to Dr. W. H. Burt, Curator of Mammals, Museum of Zoölogy, University of Michigan, for the loan of material used in this study and for the examination of specimens under question. I am further indebted to A. B. Leonard, George C. Rinker, Jack Twente, Faye Hibbard, Alice Leonard, and Henry Hildebrand, members of the field party, for their untiring efforts spent in sorting the fossils from the washed matrix and other field and camp duties. All drawings were made by Mrs. Frances Watson Horseman.

REZABEK FAUNA

The Rezabek fauna was taken from the Rezabek gravel pit in sec. 20, T. 13 S., R. 11 W., Lincoln county, Locality No. 5, Kansas. The fossils occur in compact, fine, gray silts, containing fine to coarse sand above the gravel of the above mentioned pit. These deposits are younger than the Meade formation and appear to be channeled into it at this locality.

MOLLUSCA

The Mollusks taken from this deposit were identified and reported by A. B. Leonard (Frye, Leonard and Hibbard, 1943, pp. 41-42). The following gastropods are known to occur in the deposit in association with the vertebrates.

Aquatic gastropods:

Amnicola limosa (Say)
Gyraulus cf. *hirsutus* (Gould)
Gyraulus parvus (Say)
Ferrissia parallela (Haldeman)
Helisoma trivolvis (Say)
Lymnea galbana (Say)
Lymnea humilis modicella (Say)
Lymnea palustris Müller
Lymnea sp.
Menetus kansasensis Baker
Physa anatina Lea
Planorbula armigera (Say)
Valvata tricarinata (Say)

Terrestrial gastropods:

Gastrocopta contracta (Say)
Gastrocopta procera (Gould)
Gastrocopta procera cf. *mcclungi* Hanna and Johnson
Gastrocopta tappaniana (C. B. Adams)
Hawaiia miniscula (Binney)
Helicodiscus parallelus (Say)
Succinea cf. *retusa* Lea
Stenotrema sp. (immatures)
Strobilops affinis Pilsbry
Vallonia costata (Müller)
Vallonia cf. *pulchella* (Müller)
Vertigo gouldi (Binney)
Vertigo hibbardi Baker

VERTEBRATA

A systematic description is given of the Mammalia only, although the occurrence of the other vertebrates is noted here.

CLASS PISCES

Fish bones, scales and teeth are the most abundant vertebrate remains recovered from the matrix. Associated with the Pleistocene fish remains are teeth of Cretaceous sharks which have been reworked from the surrounding Cretaceous deposits. The remains of the gar are most abundant, consisting chiefly of scales and vertebrae with a few dermal bones of the head and fragmentary jaws with teeth. Second in abundance are the remains of catfish (probably *Ameiuridae*) principally spines and a few head bones. Next in order are a number of spines apparently of sunfishes (*Centrarchidae*).

CLASS AMPHIBIA

A number of bones were recovered that belonged to frogs and toads. The remains are common in the deposit, though rather fragmentary. These are being studied by Dr. E. H. Taylor of the University of Kansas.

CLASS REPTILIA

Fragmentary remains of turtles were taken as well as a few snake and lizard vertebrae.

CLASS AVES

Bird remains appear rare in the deposit since only five fragmentary bones were found.

CLASS MAMMALIA

ORDER INSECTIVORA

FAMILY TALPIDAE

Scalopus aquaticus (Linnaeus)

(Plate XIX, fig. 16)

A right humerus, No. 6673, in nearly perfect condition was recovered that is slightly smaller than that of *Scalopus aquaticus machrinoides* Jackson from eastern Kansas. The greatest length of the humerous is 15.0 mm. The greatest width across the distal end is 9.7 mm.

FAMILY SORICIDAE

Sorex cinereus Kerr

Sorex cinereus Kerr, 1792, Animal Kingdom, p. 206.

A right ramus, No. 6674, bearing P_4-M_2, was taken, belonging to a small shrew that is referred to the above form. It is the ramus of an old adult as shown by the worn teeth. The anterior part of P_4 extends over the posterior part of P_3. The mental foramen is situated below the anterior part of M_1 and corresponds to the position observed in recent specimens from Emmit county, Michigan. The anteroposterior diameter of P_4-M_2 is 2.85 mm.

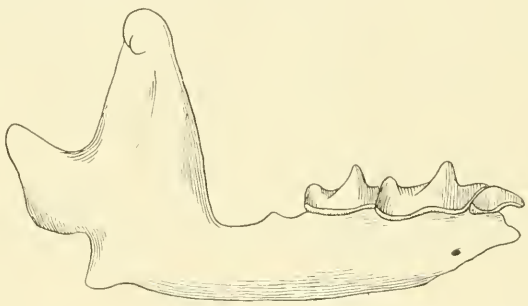

FIG. 1. *Sorex cinereus* Kerr, No. 6674, Kansas University Museum of Vertebrate Paleontology. Right ramus, P_4-M_2. × 10.

Sorex cinereus is also known from the Jones fauna (Hibbard, 1940) a later Pleistocene deposit in Meade county.

Blarina fossilis sp. nov.

Type. No. 6675, Kansas University Museum of Vertebrate Paleontology, fragmentary right ramus bearing M_3.

Horizon and type locality. Pleistocene, Locality No. 5, Lincoln county, Kansas, Rezabek fauna.

Diagnosis. The largest of the known forms of *Blarina;* M_3 larger and possesses a heavier developed cingulum.

Description of type. The ramus is that of a young adult. The anterior part is missing. It is broken at the alveolus of M_1. The roots of M_1 and M_2 are present. There is a well-developed angle on the lower border of the ramus below M_3 though not as strongly developed as in specimens of *B. b. talpoides* (Gapper) from Carroll county, New Hampshire. In comparison with specimens of eastern Kansas the angle is more strongly developed. The tip of the angular process is broken. The inferior notch between the angular process

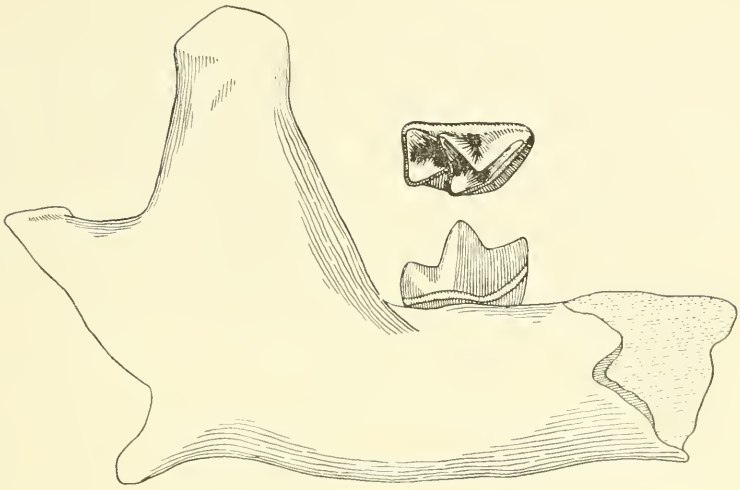

FIG. 2. *Blarina fossilis sp. nov.* holotype, No. 6675, Kansas University Museum of Vertebrate Paleontology. Right ramus, M_3. $\times 10$.

and the condyle is deeper and broader than those observed in recent specimens. Condyle and coronoid process corresponds with that of *B. b. talpoides*. The pterygoid fossa is well developed with a foramen below its ventral border that opens into it. Anterior to this foramen and slightly ventral is the mandibular foramen.

M_3 is larger in comparison to that tooth in recent forms; the cingulum is broader and forms a more pronounced ridge. The ramus is broader posterior to M_3.

MEASUREMENTS IN MILLIMETERS

	B. fossilis No. 6675 KUMVP	*B. b. hulophaga* No. 12925 KUMMV	*B. b. talpoides* No. 11279 KUMMV
M_3, anteroposterior diameter	1.55	1.25	1.25
M_3, greatest transverse width	0.9	0.7	0.8
M_3, anteroposterior length of trigonid	0.9	0.8	0.7
M_3, transverse width of trigonid above external cingulum	0.8	0.7	0.6
M_3, transverse width of talonid above external cingulum	0.6	0.6	0.5
Transverse width of ramus posterior to M_3	1.4	1.2	1.1
Depth of ramus below M_3	2.1	1.8	2.2

Discussion. *Blarina fossilis* is distinguished from *Blarina gidleyi* Gazin from the upper Pliocene of Idaho by its larger size and in that the trigonid is not elongate but the shape of that of *B. brevicauda.*

The metaconid of M_3 is more heavily developed than in the recent forms and the base is strongly developed and extends forward toward the paraconid. The protoconid is distinct and broad being constricted off from the metaconid and a more pronounced separation occurs between the protoconid and the paraconid than in the recent forms. The talonid is as large as in *B. b. talpoides* and not reduced as in *B. b. brevicauda* (Say) and *b. hulophaga* Elliot.

It differs from *Blarina b. ozarkensis* Brown from the Pleistocene of Arkansas in that it possesses a larger talonid on M_3 and a better developed angle below M_3 on the lower border of the ramus.

Blarina simplicidens Cope from the Pleistocene of Pennsylvania has the talonid of M_3 greatly reduced.

ORDER RODENTIA

FAMILY SCIURIDAE

Citellus sp.

A single right upper M^1 or M^2, No. 6730, was found that belongs to a squirrel slightly larger than *Citellus tridecemlineatus* (Mitchill). The tooth possesses a small mesostyle between the paracone and metacone such as occurs in *Citellus richardsonii* (Sabine).

FAMILY GEOMYIDAE

Geomys sp.

(Plate XIX, fig. 2)

A right M^3 and a left upper incisor, No. 6732, was found that belongs to the genus *Geomys*.

FAMILY CASTORIDAE

Castoroides sp.

(Plate XIX, fig. 1)

A fragmentary upper incisor, No. 6296, was found that belongs to the above beaver genus.

FAMILY CRICETIDAE

? *Reithrodontomys*

(Plate XIX, fig. 7)

A fragmentary right ramus, No. 6679, bearing a badly worn M_1 is questionably referred to the above genus. It is the size of *Reithrodontomys albescens* Cary.

Neotoma sp.

(Plate XIX, figs. 3, 4)

Two teeth were taken that belong to this genus. A RM^1, No. 6731a, of an immature specimen, differs from *Neotoma floridana* (Ord), found living in that area at the present time, in that the anterior reëntrant angle on the anterior loop is not as well developed. The tooth has an anteroposterior diameter of 3.4 mm. No. 6731b is a RM_2 of a young specimen. Its anteroposterior diameter is 2.8 mm.

Microtus cf. *pennsylvanicus* (Ord)

(Plate XIX, fig. 17)

A left lower ramus, No. 6289, bearing M_1 and M_2 is referred to the above species. M_1 consists of a posterior loop, six alternating closed triangles and a crescent shaped anterior loop. M_2 consists of a posterior loop and four alternating closed triangles. The anteroposterior diameter of M_1-M_2 is 4.8 mm. Twelve first lower molars were found with either five or six closed triangles.

Microtus (*Pedomys*) cf. *ochrogaster* (Wagner)

(Plate XIX, fig. 6)

Recovered from the deposit is a fragmentary left ramus, No. 6288, bearing incisor, M_1 and M_2. M_1 consists of a posterior loop, three alternating closed triangles, the fourth and fifth confluent and open broadly into the anterior loop. M_2 consists of a posterior loop, two alternating closed triangles. The third and fourth alternating triangles confluent. Anteroposterior diameter of M_1-M_2 is 4.45 mm.

I have found no definite characters by which I can separate with certainty the rami and dentitions of *Pedomys* and *Pitymys*. On the basis of the characters present the specimen resembles *Pedomys* more closely than *Pitymys*.

Neofiber leonardi sp. nov.

Type. No. 6653, Kansas University Museum of Vertebrate Paleontology, RM_1. Paratype, No. 6654, LM_1.

Horizon and type locality. Pleistocene, Lincoln county, Locality No. 5, Kansas, Rezabek fauna.

Diagnosis. Larger than *Neofiber alleni nigrescens* Howell, with external reëntrant angles broader and more forwardly directed.

Description of type. The RM_1 is that of an adult specimen. Tooth hypsodont, base open, reëntrant angles filled with cement. M_1 consists of a posterior loop, and five alternating closed triangles and an anterior loop. The external reëntrant angles broad and di-

rected more anteriorly than in the recent forms. The greatest contrast is in the third external reëntrant angle which is directed forward and is parallel to the anteroposterior axis of the tooth while in the recent specimens examined that angle is at right angles to the anteroposterior axis of the tooth. Anteroposterior diameter of M_1 is 5.55 mm. Greatest transverse width is 2.35 mm. Length of tooth is 8.5 mm.

This species is named for Doctor A. Byron Leonard who has devoted much of his time to collecting and studying Kansas faunas.

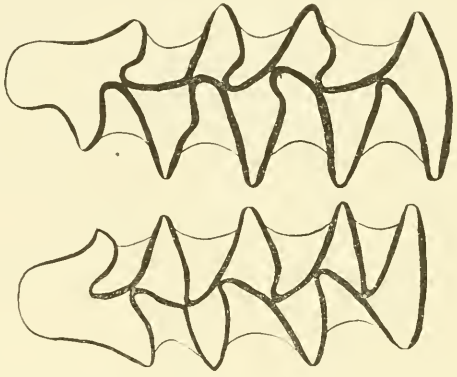

FIG. 3. Upper fig. *Neofiber leonardi sp. nov.*, holotype, No. 6653, Kansas University Museum of Vertebrate Paleontology. Right M_1 occlusal view. Lower fig. Paratype, No. 6654, KUMVP. Left M_1. $\times 10$.

Discussion. The paratype differs in that the fourth internal reentrant angle extends well past the third external reëntrant angle. The anteroposterior diameter of the tooth is 5.3 mm.

Remains of fossil *Neofiber* sp. and *Neofiber alleni* True have been reported from the Pleistocene of Florida by Sellards (1916) and others. These remains have been taken in the area of its present range. Gidley (1922, p. 127) assigned an upper tooth with closed roots from the Pleistocene deposits of Arizona (Curtis ranch fauna), to *Neofiber*. Gazin (1942, p. 511) assigns the same tooth to *Ondatra*. On the basis of the closed base of the tooth it cannot belong in the genus *Neofiber*.

Ondatra zibethica (Linnaeus)

(Plate XIX, figs. 9, 10, 11, 12)

Four molars were recovered that are indistinguishable from those of the above species. The base of the teeth are closed and possess well-developed roots. A RM^1, No. 6676, has anteroposterior di-

ameter of 4.5 mm. No. 6290b is a LM^2 of an adult specimen with an anteroposterior diameter of 3.6 mm. This tooth is slightly smaller than those of adult specimens of *O. z. cinnamomina* (Hollister) that now live in that area. No. 6290a is the LM_2 of an immature specimen, with an anteroposterior diameter of 2.95 mm. A LM^3, No. 6677, of an adult specimen has an anteroposterior diameter of 3.85 mm.

It is impossible to compare the Kansas material with the form *O. nebracensis* Hollister from the Pleistocene quarries near Hay Springs, Sheridan county, Nebraska, since the Nebraska species possesses teeth identical with those of the living species and is distinguished only by cranial characters.

ORDER LAGOMORPHA

FAMILY LEPORIDAE

? *Sylvilagus* sp.

(Plate XIX, figs. 13, 14, 15)

Three premolars or molars, No. 6678, of a small rabbit are questionably referred to the genus *Sylvilagus*. The teeth are the size of those of *Sylvilagus floridanus mearnsii* (Allen) though the reëntrant valleys of the upper molars are not as crenulated. This is the first known occurrence of what appears to be the cottontail in the Pleistocene deposits of Kansas.

ORDER PERISSODACYTLA

FAMILY EQUIDAE

Equus cf. *niobrarensis* Hay

(Plate XIX, fig. 5)

A fragmentary upper molar, No. 6287, is referred to the above form. This is the only fossil, except shark teeth, that has been recovered by Mr. Rezabek during the years that sand and gravel have been removed from the quarry.

ORDER ARTIODACTYLA

FAMILY CERVIDAE

Odocoileus sp.

(Plate XIX, fig. 8)

The base of a right antler, No. 6505, the size of the black-tailed deer, was recovered. The antler was well fossilized and broken in removing the silt layer that occurs above the sand and gravel deposit. This is the second specimen of *Odocoileus* to be recovered from the Pleistocene of Kansas, the other was an upper left molar from Harvey county, belonging to a much smaller deer (Hibbard, 1939, p. 469).

Discussion. From the genera and species of mammals known from the Rezabek fauna it is impossible at the present time to make any correlation with other known deposits in the Pleistocene of Kansas or Nebraska. It is a younger fauna than either the Cudahy of Meade county, the Tobin of Russell county or the Wilson Valley of Lincoln county, which occur in the silt directly below the Pearlette ash member of the Meade formation and which are considered as glacial faunas. The Rezabek fauna is also considered younger than the Borchers, an interglacial fauna, that occurs in the Meade formation just above the Pearlette ash. The Rezabek fauna was taken from a deposit that is channeled into the Meade formation.

The stream that laid down the deposit from which the Rezabek fauna was collected is considered as having been a large permanently flowing stream and is so considered because of the abundance of fish remains, especially gars. The climatic condition is considered as temperate (interglacial). The presence of *Neofiber* cannot be given too great a consideration since its Pleistocene distribution is not known. Its present distribution is restricted and it appears to be one of those forms that either became stranded at the close of the Pleistocene or is in the early stages of extinction.

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PLATE XIX

FIG. 1. *Castoroides* sp. No. 6296, part of upper incisor. × 1.

FIG. 2. *Geomys* sp. No. 6732, RM^3, occlusal view. × 10.

FIG. 3. *Neotoma* sp. No. 6731a, RM^1, occlusal view. × 6.

FIG. 4. *Neotoma* sp. No. 6731b, RM_2, occlusal view. × 6.

FIG. 5. *Equus* cf. *niobrarensis* Hay. No. 6287, part of upper molar, occlusal view. × 1.

FIG. 6. *Microtus* (*Pedomys*) cf. *ochrogaster*. No. 6288, LM_1-M_2, occlusal view. × 10.

FIG. 7. *?Reithrodontomys*. No. 6679, right ramus. × 10.

FIG. 8. *Odocoileus* sp. No. 6505, base of right antler. × 1.

FIG. 9. *Ondatra zibethica*. No. 6676, RM^1, occlusal view. × 6.

FIG. 10. *Ondatra zibethica*. No. 6290b, LM^2, occlusal view. × 6.

FIG. 11. *Ondatra zibethica*. No. 6677, LM^3, occlusal view. × 6.

FIG. 12. *Ondatra zibethica*. No. 6290a, LM_2, occlusal view. × 6.

FIG. 13. *?Sylvilagus*. No. 6678a, upper molar, occlusal view. × 6.

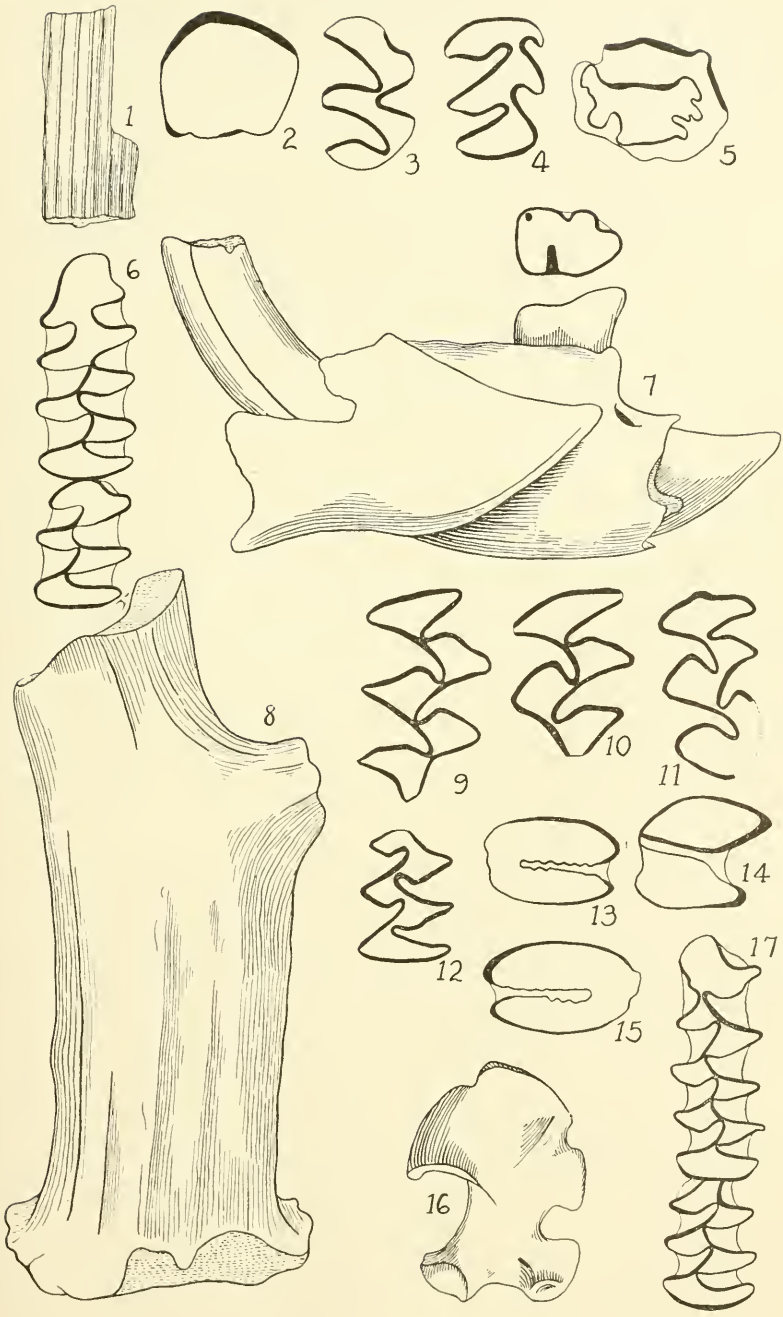
FIG. 14. *?Sylvilagus*. No. 6678b, right lower molar, occlusal view. × 6.

FIG. 15. *?Sylvilagus*. No. 6678c, upper molar, occlusal view. × 6.

FIG. 16. *Scalopus aquaticus*. No. 6673, right humerus. × 2.

FIG. 17. *Microtus* cf. *pennsylvanicus*. No. 6289, LM_1-M_2, occlusal view. × 10.

Plate XIX



THE UNIVERSITY OF KANSAS
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An Extinct Turtle of the Genus *Emys* from the Pleistocene of Kansas

By EDWARD H. TAYLOR

ABSTRACT: A species of Pleistocene turtle, *Emys twentei sp. nov.* is described from a locality 13 miles southwest of Meade, Meade county, Kansas. It is the only known fossil species of this genus (*sensu stricto*) in the Western Hemisphere.

THE summer expedition of the University of Kansas Museum of Vertebrate Paleontology in 1942, under the direction of Doctor Claude Hibbard, recovered from the Pleistocene high terrace deposits of Meade county, Kansas, the greater portion of the carapace of a fossil turtle. The discovery of the turtle, exposed at the surface, was made by Mr. Jack Twente, a member of the expedition. The species is named in his honor.

Doctor Hibbard revisited the locality and additional fragments of the same carapace were found scattered about. These he recovered and carefully fitted them together with the parts already taken.

The specimen, recently placed in my hands for study by Doctor Hibbard, proves to be an undescribed form of the genus *Emys*. This genus is represented in the Western Hemisphere by a single living species, *Emys blandingii* (Holbrook), that ranges through the Northern United States from Nebraska to New Jersey, and enters southern Canada. It has never been taken in Kansas, the nearest approach being Buffalo county, Nebraska. It has been reported in four counties* north of the Platte river in Nebraska.

* Reported from Cherry, Stanton, Thomas and Buffalo counties in Nebraska by George E. Hudson, The Amphibians and Reptiles of Nebraska, Nebraska Conservation Bulletin, No. 24, June, 1942, pp. 1-146, pls. I-XX, maps 1-32.

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Emys twentei sp. nov.

Holotype. University of Kansas Museum of Vertebrate Paleontology No. 6478; a turtle carapace, lacking the anterior end; collected by Doctor Claude W. Hibbard and party, summer of 1942.

Horizon and type locality. High terrace sands of Pleistocene Age on the north side of the Cimarron river, 13 miles southwest of Meade, Meade county, Kansas (Loc. No. 7, XI Ranch).

Diagnosis. A medium-sized turtle belonging to the genus *Emys,* related to *Emys blandingii,* but differing in having a carapace broader in proportion to its length, the bridge of the plastron wider and the extremely large vertebral plates much wider than the costal plates and wider than similar scales in *Emys blandingii.*

Description of type. Carapace relatively high, its elevation, 78 mm., equal to half its greatest width, 155 mm., and contained in its length (estimated at 220 mm.) 2.82 times. Presuming that the parts missing from the carapace, conform as well to the generic pattern as those parts do that are present, one may postulate the following complete scale and bone formulae:

Scutes: 1 nuchal, 5 vertebrals, 2 pygals, 4 costals, 11 marginals.

Bones: 1 nuchal, 8 neurals, 1 suprapygal, 1 pygal, 8 costals, 11 marginals.

There are ten ribs that contact the vertebrae, two each arising from the first and last costals; two vertebrae are attached to each of the neurals. The last neural is apparently a compound element composed of a second suprapygal and the eighth neural. The last vertebra, with a rib, is not attached to it.

The carapace, compared with a carapace of *Emys blandingii* of nearly equal length, presents the following differences. The distinct scars of the vertebral scutes show that these scales were considerably broader, while their length is nearly the same as in *E. blandingii.* The costal scutes on the other hand are of nearly the same size. The pygal scutes of the fossil have shorter marginal borders (⅓ less) and a somewhat deeper notch than these scales in *E. blandingii;* the neurals are wider for the most part but have approximately the same length. The exceptions are the seventh neural, which is considerably wider but shorter, and the eighth which is longer and wider, than the same scales in the living form.

The second costal has about the same transverse width, the third is decidedly wider, the fourth about the same as the corresponding scales in *E. blandingii.* The suprapygal is less widened, but about the same length.

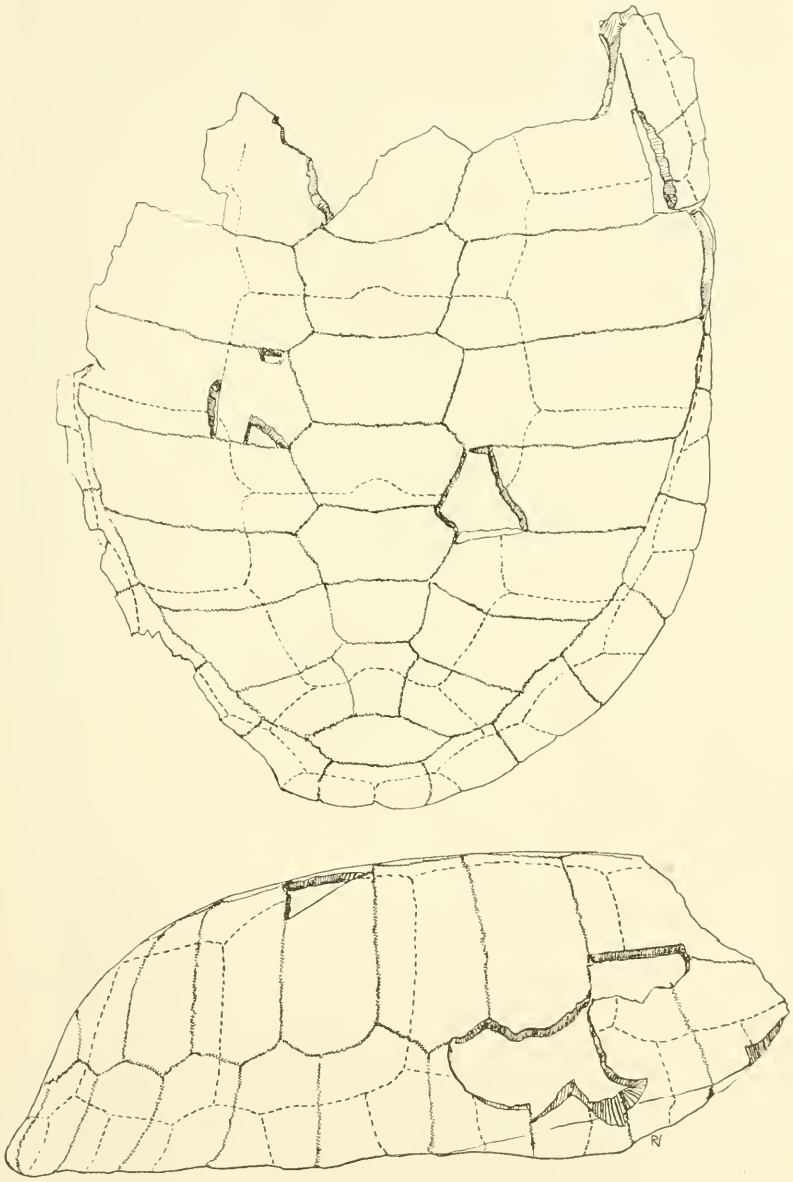

PLATE XX. *Emys twentei sp. nov.* From type, University of Kansas Museum of Vertebrate Paleontology, No. 6478, 13 miles southwest of Meade, Meade county, Kansas.

The free part of the fossil ribs are heavier than those in the living species, especially those arising from the eighth costals. The articulating surface for the ilium has a more pronounced elevation and a

wider surface. The scar on the inner lower edge of the carapace formed by the ligamentous attachment of the plastron is distinctly longer and the marginal bones are actually thicker in the fossil than in *blandingii*.

Measurements of type:

Total length of carapace (estimated)	220
Total width	155
Greatest height	78
Third vertebral scute (length and width)	45-72
Fourth vertebral scute (length and width)	51-61
Fifth vertebral scute (length and width)	48.5-47
First costal* scute (length and width)	? -52
Second costal scute (length and width)	49-59
Third costal scute (length and width)	50-58
Fourth costal scute (length and width)	42.2-47.7
Pygals (marginal width combined)	46.5
Second neural plate, median (length and width)	? -37
Third neural plate, median (length and width)	23-39
Fourth neural plate, median (length and width)	21-39
Fifth neural plate, median (length and width)	17-36
Sixth neural plate, median (length and width)	15-23
Seventh neural plate, median (length and width)	25-18
Suprapygal neural plate, median (length and width)	25-33.5
Pygal neural plate, median (length and width)	22.5-25
Second costal (right side, width and length)	64-25
Third costal (right side, width and length)	74-24
Fourth costal (right side, width and length)	73-25
Fifth costal (right side, width and length)	66-24
Sixth costal (right side, width and length)	59-23.5
Seventh costal (right side, width and length)	54-18
Eighth costal (right side, width and length)	38-19
Total length of plastral attachment	84

Remarks. The present distribution of *Emys* points to the fact that it is an ancient group and one that is marked for extinction. Its age is attested by the discoveries of fossil forms as early as the Oligocene.

The one living species known from the Western Hemisphere, *Emys blandingii* (Holbrook), has a range confined to the northern part of the United States, from Nebraska east to New Jersey, and north to southern Canada. Throughout much of its range it is regarded as rare.

In the Eastern Hemisphere there is a single living species, *Emys orbicularis* Linnaeus, with a distribution on three continents. In Europe it occurs in Spain, Italy, Saxony, Holland, Bulgaria (pygmy

* Measurement of costals are made on the curve. The "width" representing their long dimension.

form), Sweden, Eastern Russia, and Poland; in Asia it has been found in Astrakan, Caspian Sea Region, and Kurdistan; in Africa it is known in Algeria and Morocco. It is reputed to be disappearing from Europe, being known to have become extinct in Switzerland in historic time. Possibly one cause for its disappearance is the fact that it is widely used for food and is sold in various European markets. It is known in fossil form from Pleistocene deposits of Sweden, Denmark, Norfolk, Belgium, Germany, Switzerland, and Lombardy.

Several fossil forms of the genus have been described from Europe. *Emys turfa* H. v. Meyer, *Emys lutaria borealis* Nilsson have been referred to the living *Emys orbicularis* Linnaeus. Recently three fossil forms have been referred to this genus, which carry the history of the genus back to the Oligocene. These apparently are properly associated with the genus *Emys* as understood at the present time.

Szalai (1934) described *Emys strandi* from the Upper Oligocene of Hungary, and Bergounioux (1935) described *Emys grepiacensis* from the Oligocene of Toulouse, France, and *Emys aquitanensis* from the Miocene of Sansan.

In North America, in the older literature, a large number of fossils have been referred to the genus *Emys*. However, subsequent studies of Cope, Hay and others have resulted in placing the forms so referred in other genera.* Not one has been left in the genus *Emys*.

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*

DERMATEMYDIDAE

Emys obscurus Leidy	= *Compsemys obscurus* (Leidy)
Emys beatus Leidy	= *Adocus beatus* (Leidy)
Emys parva Maack *Emys pravus* Leidy	= *Adocus pravus* (Leidy)
Emys turgidus Cope	= *Agomphus turgidus* (Cope)
Emys petrosus Cope	= *Agomphus petrosus* (Cope)
Emys firmus Leidy	= *Agomphus firmus* (Leidy)
Emys gravis Cope	= *Notomorpha gravis* (Cope)

EMYDIDAE

Emys latilabiatus Cope (part) *Emys lativertebralis* Cope	= *Echmatemys lativertebralis* (Cope)
Emys stevensonianus Cope *Emys cibollensis* Cope	= *Echmatemys cibollensis* (Cope)
Emys megaulax Cope *Emys pachyomus* Cope	= *Echmatemys? megaulax* (Cope)
Emys testudineus Cope	= *Echmatemys testudinea* (Cope)
Emys euthnetus Cope	= *Echmatemys euthneta* (Cope)
Emys wyomingensis Leidy (part) *Emys jeansi* Leidy *Emys jeanesianus* Leidy	= *Echmatemys wyomingensis* (Leidy)
Emys haydeni Leidy	= *Echmatemys haydeni* (Leidy)
Emys stevensonianus Leidy *Emys stevensoni* Leidy	= *Echmatemys stevensonianus* (Leidy)
Emys septaria Cope	= *Echmatemys septaria* (Cope)
Emys Shaughnessiana Cope	= *Echmatemys shaughnessiana* (Cope)
Emys latilabiatus Cope	= *Echmatemys? latilabiata* (Cope)
Emys polycyphus (Cope)	= *Palaeotheca polycepha* Cope
Emys terrestris (Cope)	= *Palaeotheca terrestris* Cope
Emys euglypha Leidy	= *Trachemys euglypha* (Leidy)
Emys petrolei Leidy	= *Trachemys petrolei* (Leidy)

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TESTUDINIDAE

Emys nebrascensis Leidy *Emys lata* Leidy *Emys hemispherica* Leidy *Emys oweni Leidy* *Emys culbertsoni* Leidy	= *Stylemys nebrascencis* Leidy
Emys carteri Leidy	= *Hadrianus corsoni* (Leidy)

THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

VOL. XXIX, pt. II.] OCTOBER 15, 1943 [No. 4

A New Meadow Mouse (*Microtus ochrogaster taylori*) from Meade County, Kansas

By CLAUDE W. HIBBARD and GEORGE C. RINKER,
University of Kansas Museum of Natural History

ABSTRACT: A new meadow mouse, *Microtus ochrogaster taylori*, nov. subsp., is described from Meade county, Kansas. The type and paratypes were collected from a bog area in association with *Cryptotis parva parva* (Say), *Reithrodontomys megalotis aztecus* (Allen) and *Peromyscus maniculatus* cf. *nebrascensis* (Coues).

THE Kansas University Museum of Vertebrate Paleontology field party has been collecting vertebrate fossils each summer since 1936 in Meade county, Kansas, and surrounding area. Until the summer of 1941 the only species of Recent microtines collected from that area was *Ondatra zibethica cinnamomina* (Hollister). In the summer of 1941 a good series of *Synaptomys cooperi paludis* Hibbard and Rinker was taken from a bog area in Meade county. During the past six summers all valleys, pastures and meadowland covered with bluestem, side oats gramma (*Bouteloua curtipendula* Michx.) or any of the tall grasses had been examined for signs of *Microtus*. All owl pellets found had also been examined, and no signs whatsoever had been observed of this genus.

Henry H. Hildebrand, a member of our field party for the past two summers, returned to his home just north of Fowler, Kansas, at the time University classes were out in the spring of 1942, and before our party left for the field. Since there was a large bog on the Hildebrand farm he endeavored to trap a series of *Synaptomys* from the area. His first night's catch yielded a single *Microtus*, and to him belongs the entire credit of locating the colony. When the party arrived in the field, we made plans to trap this area as soon as our work permitted. Advantage was taken of two rainy days that kept us from our fossil work, which allowed us to take

the series of skins which form the basis of this paper. The specimens have been found to differ appreciably from other races in North America.

We are greatly indebted to the following persons for the loan of specimens used in this study: Mr. C. D. Bunker, Curator, University of Kansas Museum of Modern Vertebrates, Lawrence, Kansas; Mr. B. Patterson Bole, Jr., Curator of Mammals, Cleveland Museum of Natural History, Cleveland, Ohio; Dr. Karl P. Schmidt, Field Museum of Natural History, Chicago, Illinois; and Dr. G. C. Rinker of Hamilton, Kansas; also to Dr. Worthie Horr, of the Department of Botany, University of Kansas, for the identification of plants.

All drawings were made by Mrs. Frances Watson Horseman.

The new meadow mouse may be designated *Microtus ochrogaster taylori* subsp. nov.

Holotype. Female adult, skull and skin, No. 14126, collection of University of Kansas Museum of Modern Vertebrates; collected by George C. Rinker, June 17, 1942, from the bog area on the farm of H. H. Hildebrand, one and one-half miles north of Fowler, Meade county, Kansas.

Paratypes. Nos. 14107, immature male; 14108, immature male; 14109, adult female; 14110, subadult female; 14111, adult male; 14112, adult female, M_3 not normal; 14113, adult female; 14114, adult female; 14115, adult male; 14116, subadult female; 14117, immature male; 14118, immature female; 14119, adult female; 14120, adult male; 14121, adult female, M_3 not normal; 14122, adult female, M_3 not normal; 14123, adult male; 14124, immature female; 14125, immature male; 14127, adult female; 14128, adult male; 14129, adult female; 14130, adult male, M_3 not normal; 14131, adult male, M_3 not normal; 14132, adult male, LM_3 not normal; 14133, immature male; 14134, immature female, 14135, immature male; 14136, adult female.

Distribution. Type locality (see discussion).

Diagnosis. Larger than *Microtus ochrogaster ochrogaster* (Wagner). Measurements in millimeters of type; total length, 159; tail, 34; hindfoot, 20; ear, 11. The presence of the interorbital ridge distinguishes it from both *Microtus ochrogaster haydenii* (Baird) and *M. o. ochrogaster,* (see fig. I, A & B). Color distinct from the gray coloration of *haydenii,* and the grizzled appearance of *M. o. ochrogaster.*

Color of type. Summer pelage (June) back and rump show a predominance of hairs tipped with cinnamon, the presence of the black

guard hairs giving an effect of snuff-brown. Flanks and cheeks paler than back; underfur of upper parts a dark neutral gray. Belly slightly washed with pale ochraceous-buff. An ochraceous-salmon spot is present at the base of the ear and in front of the fore limb on the side of the shoulder. Tail, above darker than back; below a darker ochraceous than the belly. Color nomenclature, Ridgway, 1912.

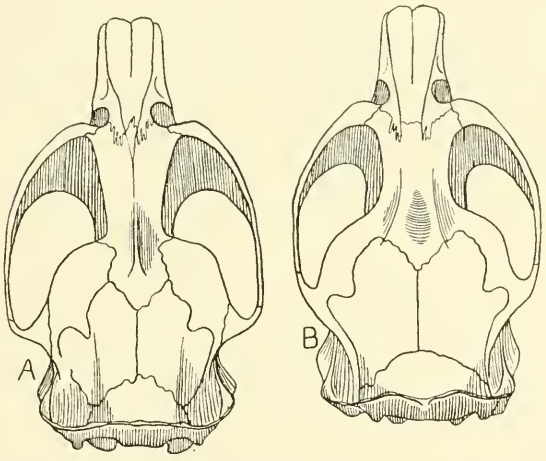

FIG. 1, A. *Microtus ochrogaster taylori subsp. nov.,* holotype, Kansas University Museum of Modern Vertebrates No. 14126, adult ♀. Dorsal view of skull, × 2.

FIG. 1, B. *Microtus ochrogaster ochrogaster* (Wagner), topotype, Cleveland Museum of Natural History No. 13599, adult ♂. New Harmony, Posey county, Indiana. Dorsal view of skull, × 2.

Skull and dentition of type. Skull similar to *Microtas o. haydenii* though not as long or as wide, when compared with specimens of the same size, and upper incisors not as heavy. The temporal ridges meet posterior to the interorbital constriction and a pronounced interorbital ridge is present, a character not common in *M. o. ochrogaster* or *haydenii.* Measurements in millimeters; condylonasal length, 28.3; basilar length of hensel, 24.4; greatest zygomatic breadth, 16.3; diastema, 8.5; width of upper incisors, 2.4; maxillary tooth row, 6.5; mandibular tooth row, 6.4; greatest width of lower jaws measured across tip of angles, 13.0. Upper and lower dentition normal, see fig. 2, A. & B.

The subspecies is named in honor of Doctor Edward H. Taylor of the University of Kansas.

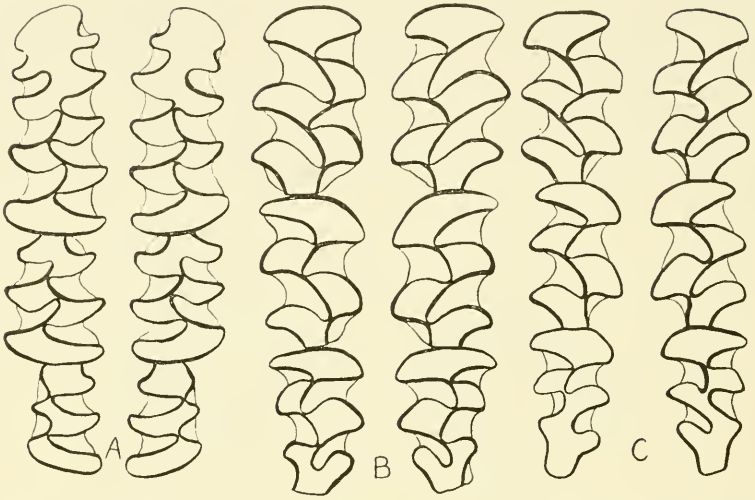

FIG. 2. Teeth of *Microtus ochrogaster*. A. *Microtus ochrogaster taylori* subsp. nov., holotype. Occlusal view LM_1-M_3 and RM_1-M_3. B. *Microtus ochrogaster taylori* holotype. Occlusal view RM^1-M^3 and LM^1-M^3. C. *Microtus ochrogaster ochrogaster* (Wagner), topotype, Cleveland Museum of Natural History, No. 13599. Occlusal view of RM^1-M^3 and LM^1-M^3. All $\times 10$.

Variation in paratypes. The paratypes range in size from an immature male, length 105 mm., to an adult male with a length of 180 mm. Immature coloration not greatly different than that of the type, the back and rump showing more of the dark neutral gray of the underfur because of the shortness of the guard hairs. The coloration of the adults varies in two extremes from the type. One adult is a light snuff-brown in appearance due to the lack of numerous black-tipped guard hairs. Five of the specimens show a slightly gray effect upon close examination, one being nearly as light as *M. o. haydenii* but distinctly separated by the light cinnamon-wash present throughout back, rump and sides. Fourteen adult specimens conform in coloration to the type. One male is slightly darker, due to the greater number of black tipped guard hairs. The bellies vary slightly from near silver with a faint wash of ochraceous to a darker ochraceous than that possessed by the type.

A series of four adults and three immatures were collected by Henry Hildebrand, December 24 and 26, 1942, from the type locality. At the same time he also caught ten specimens of *Cryptotis p. parva* in their runways. This series in winter pelage, in comparison with the type, which is June caught, has a denser fur, the back and rump

darker, with the cinnamon tipped hairs richer in color and not bleached as in the summer caught specimens; bellies with greater amount of ochraceous buff.

In comparison with winter specimens of *Microtus ochrogaster* from eastern Kansas, winter specimens of *M. o. taylori* are distinct due to the lack of gray tipped hairs. Fur slightly longer.

Of the thirty skulls of *M. o. taylori*, six possess M_3's with pattern showing variation from the normal (see fig. 4, G. & H.).

Average and extreme skull measurements (in millimeters) of the type and twenty-one paratypes, consisting of eight adult males and fourteen females, of which one is immature and one subadult; condylonasal length, 28.0 (24.2-30.7); zygomatic breadth, 16.49 (14.5-

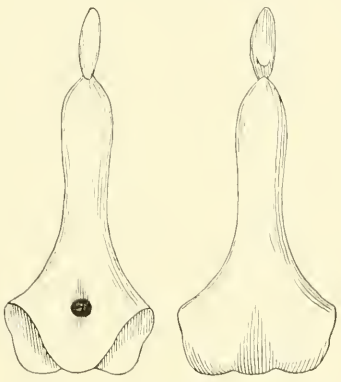

Fig. 3. *Microtus ochrogaster taylori.* Baculum, ventral and dorsal view, × 12.

17.3); nasals, 7.1 (6.5-8.4); diastema, 8.2 (6.6-9.15); maxillary tooth row, 6.5 (6.0-7.1); mandibular tooth row, 6.5 (5.9-7.0); greatest width of lower jaw measured across tip of angles (15 specimens) 13.2 (11.5-15.0). For external measurements see Table I.

A series of bacula were saved and prepared for study in the laboratory. The base differs considerably from that of *Synaptomys* (see fig. 3). At the anterior tip of the shaft is a second small bone attached to the main shaft by connective tissue. Special care was taken in cleaning the bacula and only a median element was found and no evidence of lateral ossifications. In the immature males the median bone at the tip of the shaft had not been formed although a tissue mass occupied its position.

Comparison of Microtis ochrogaster taylori with other M. ochrogaster. A series of seven adult topotypes of *M. o. ochrogaster,* three

males and four females, from New Harmony, Posey county, Indiana, in September pelage, was used for comparison. The color of these specimens is darker, possessing a definite grizzled appearance on rump, back and head due to the light tipped hairs in contrast to the black tipped guard hairs. The type of *M. o. taylori* lacks the grizzled appearance. The skulls of these specimens are not as robust, the temporal ridges do not converge to form a single orbital ridge as in *M. o. taylori* but the ridges extend across the orbit producing a shallow groove between them. The anterior part of the brain case does not form as sharp an angle in relation with the rostrum as in *M. o. taylori* (see fig. I, A & B). The measurements in millimeters of the seven adult topotypes of *M. o. ochrogaster,* nos. 13592, 13595, 13598, 13599, 13603, 13604, 13605, of the Cleveland Museum of Natural History collection are as follows: condylonasal length, 26.1 (24.3-27.2); zygomatic breadth, 14.4 (13.1-15.85); nasals, 7.1 (6.9-7.5); diastema, 7.5 (6.75-8.4); maxillary tooth row, 5.8 (5.5-6.2); mandibular tooth row, 5.7 (5.3-6.5); greatest posterior width of lower jaws measured across tip of angles, 10.9 (9.6-12.2). Upper and lower dentition normal. For external measurements see Table I.

M. o. taylori was compared with a series of *M. o. haydenii* from Rawlins county, Kansas, in July pelage and a single specimen, Field Museum, No. 21878, from Cherry county, Nebraska. *M. o. taylori* can be separated at once from *haydenii* which possesses a decidedly lighter grayish color and a silvery belly. Adult skulls of *haydenii* from Rawlins county average longer and broader and do not possess the strongly developed rostral ridge formed by the meeting of the

TABLE I.—Table of External Measurements of *Microtus o. taylori; M. o. ochrogaster; M. o. haydenii* and *M. ochrogaster* (in millimeters)

SPECIES.	Locality.	Total length.		Tail.		Hindfoot.		Ear.		No. measured.
		Average.	Extremes.	Average.	Extremes.	Average.	Extremes.	Average.	Extremes.	
M. o. taylori	Meade Co., Kans.	160.0	141.0–180.0	35.4	30.0–42.0	21.0	20.0–22.0	11.2	10.0–13.0	22
M. o. ochrogaster	Posey Co., Ind.	154.8	141.0–169.0	29.2	27.0–34.0	___	___	___	___	7
M. o. haydenii	Rawlins Co., Kans.	155.5	145.0–172.0	40.0	39.0–41.0	21.25	20.0–22.0	13.0	11.0–14.0	4
M. ochrogaster	Douglas Co., Kans.	150.0	142.0–165.0	34.4	29.0–40.0	___	___	___	___	19
M. ochrogaster	Greenwood Co., Kans.	154.8	142.0–181.0	35.0	29.0–46.0	___	___	___	___	16

temporal ridges as in *M. o. taylori*. Average and extremes of four adult males of *M. o. haydenii* from northeast Ludell, Rawlins county, Kansas; condylonasal length 28.8 (28.6-29.3); zygomatic breadth, 16.7 (16.0-17.5); nasals, 8.3 (8.2-8.4); diastema, 8.6 (8.4-9.1); maxillary tooth row, 6.3 (6.0-6.8); mandibular tooth row, 6.4 (6.0-6.6); greatest posterior width of lower jaws measured across tip of angles (one specimen) 13.0. Upper dentition normal; M_3 not normal in one specimen. For external measurements see Table I.

There is a single specimen of *M. ochrogaster*, No. 1066, in the K. U. collection from Logan county, Kansas, taken November, 1892. It is a specimen of an immature female, the skull compares well with that of *M. o. haydenii* though the pelage is badly bleached and appears to have been made from an alcoholic specimen, being of no value for comparative study.

A single specimen, K. U. No. 3498, taken July 18, 1921, at Coolidge in Hamilton county, Kansas, compares perfectly in coloration with that of the type of *M. o. taylori* but differs from the Meade specimens in that it does not possess the posterior interorbital ridge. Its skull is like those of a series of *Microtus ochrogaster* in the Field Museum collection taken three miles west of Alva, Woods county, Oklahoma. The December caught specimens from Meade county, possess a coloration like the specimens from Woods county which were taken February 21, and are in winter pelage. The measurements of six adults, four males and two females, from Woods county, Oklahoma, Field Museum specimens Nos. 6816, 6817, 6818, 6819, 6820, and 6821 are as follows; average and extremes, length of body, 147.5 (138.0-154.0); tail, 32.8 (30.0-38.0); condylonasal length, 27.0 (25.7-29.0); zygomatic breadth, 15.5 (14.6-16.4); nasals, 7.3 (7.0-7.9); diastema, 8.1 (7.5-9.0); maxillary tooth row, 6.3 (6.2-6.5); mandibular tooth row, 6.3 (6.1-6.6); greatest posterior width of lower jaws measured across tip of angles, 12.5 (one specimen). Upper dentition normal; one specimen with M_3 pattern showing variation from normal. The skulls of the Woods county specimens are distinct from those of *Microtus o. ochrogaster* and compare in from and size with those of *Microtus* taken west of the Missouri river, though none of the skulls possess the interorbital ridge present on the Meade county skulls. This character is not an age difference, though the ridge as a rule becomes more strongly developed in old adults possessing the ridge in subadult development. The Hamilton county, Kansas, specimen and the Woods county, Oklahoma, specimens are referred to *Microtus o. taylori*.

In the Kansas University Museum collection there are only five summer caught specimens from eastern Kansas, ranging from Doniphan county, in the extreme northeastern corner of the state to Cherokee county, in the extreme southeastern corner of the state. In coloration these specimens are distinct from the Meade county specimens and those of *M. o. haydenii* from Rawlins county. There is a slight change in colloration from north to south across the state but the series is too small to allow accurate comparison. They lack the snuff-brown appearance of *M. o. taylori.* In fact they compare

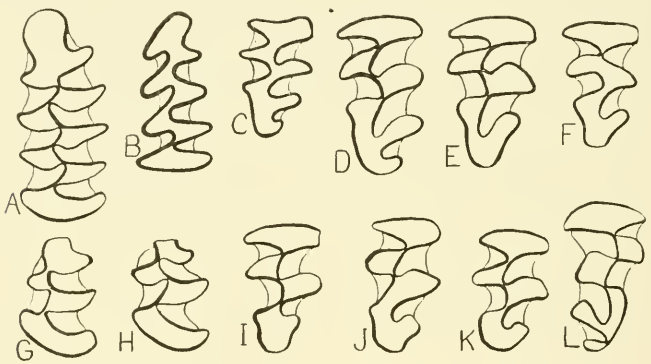

FIG. 4. Occlusal view of the teeth of *Microtus ochrogaster* (subspecies), showing variation in tooth pattern in eastern Kansas. A. No. 1038 Kansas University, LM_1 Douglas county. B. No. 1030 K. U., LM_1 immature, Douglas county. C. No. 1030 K. U., RM^3 immature, Douglas county. D. No. 4557 K. U., RM^3, Douglas county. E. No. 6819 Field Museum, RM^3, Woods county, Oklahoma. F. No. 1026 K. U., RM^3, Douglas county. G. No. 8041 K. U., LM_3, Greenwood co. H. No. 8042 K. U., RM_3, Greenwood county. I. No. 1080 K. U., RM^3, Douglas county. J. No. 3282 K. U., RM^3, Douglas county. K. No. 11831 K. U., RM^3, Rawlins county. L. No. 6819, Field Museum, LM^3, Woods county, Oklahoma. All $\times$ 10.

more nearly with the summer pelage of *M. o. ochrogaster* in that they show a grizzled effect which extends from the tip of the nose, throughout the upper parts but they possess definitely the *haydenii* type of skull. The eastern Kansas specimens seem to belong to a distinct race which is more closely related to *M. o. haydenii* than to *M. o. ochrogaster* based upon skull characters and not coloration.

In the Kansas University Museum collection there are 177 winter caught specimens of *Microtus ochrogaster,* chiefly from Douglas and Greenwood counties, (see map for localities from which specimens have been taken in Kansas). These specimens are distinct in coloration from the winter caught specimens taken near Alva, Woods county, Oklahoma, and the Meade county specimens. The measure-

ments of the sixteen largest adult specimens, nine males and seven females taken in Greenwood county, Kansas, are as follows: average and extremes, condylonasal length of skull, 27.2 (25.4-29.0); zygomatic breadth, 15.2 (14.15-16.3); nasals, 7.5 (7.0-8.2); diastema, 8.3 (7.0-9.0); maxillary tooth row, 6.09 (5.5-6.7); mandibular tooth row, 5.8 (5.2-6.2); greatest posterior width of lower jaws measured across tip of angles, 12.3 (11.4-13.0). For external measurements see Table I. Measurements of the nineteen largest adult specimens, six males, ten females and three of undetermined sex taken in Douglas county, Kansas, are as follows: average and extremes, condylonasal length of skull, 27.09 (25.3-28.7); zygomatic breadth, 15.66 (14.9-16.5); nasals, 7.5 (6.4-8.7); diastema, 8.4 (8.0-8.8); maxillary tooth row, 6.0 (5.6-6.5); mandibular tooth row, 6.23 (5.9-6.7); greatest posterior width of lower jaws measured across tip of angles, 12.5 (10.9-13.5). For external measurements see Table I. In 194 specimens from eastern Kansas, including twelve from Dr. G. C. Rinker's collection, 33 individuals possessed an M_3 with pattern showing variation from normal, (see fig. 4, G & H), two possessed a variation in pattern of M_1, (see fig. 4, A), and eight individuals possessed varied M^3 patterns (see fig. 4). The greatest percentage of variation in the M_3 patterns was found in specimens from southeastern Kansas.

From field notes and data on the specimens in the University Museum collection and Dr. Rinker's collection the following information upon the size and date of the occurrence of embryos found in females of *Microtus ochrogaster* are given in Table II. Records of embryos were not kept on the early collected females. The smallest recorded female containing embryos from eastern Kansas had a total length of 140.0 mm. while the largest female had a total length of 181.0 mm.

Food and habits of Microtus o. taylori. Due to the limited time close observations upon the food habits of *Microtus o. taylori* were not possible but they were found to be feeding chiefly upon the fox tail barley (*Hordeum jubatum* Linn.). Rolled oats and raisins were used as bait which was placed on snaptraps in their numerous runs in a patch of foxtail barley and where their runs came out of the dense growth of sedges. They took the bait readily and it was observed in their mouths and stomachs. Eight specimens were caught the evening of June 17 while the traps were being set. Sixteen were caught that night and eight more the night of July 10. Taken in the runs with the *Microtus* were two specimens of *Reithrodontomys megalotis aztecus* and 12 specimens of *Peromyscus maniculatus* cf.

TABLE II.—Record of Embryos of *Microtus ochrogaster*

DATE.	Number of embryos per female.	Stage of development.	Locality.
Jan. 14	3		Douglas county, Kansas
Jan. 29	5	4.0 mm	Douglas county, Kansas
Jan. 29	3	15.0 mm	Douglas county, Kansas
Jan. 29	3	Nearly full term	Douglas county, Kansas
Feb. 10	5	Large	Greenwood county, Kansas
Feb. 11	4	Small	Greenwood county, Kansas
Feb. 12	3	17.0 mm	Edmondson county, Kentucky
Feb. 12	3		Edmondson county, Kentucky
Feb. 13	3	27.0 mm	Douglas county, Kansas
Feb. 17	3	Very small	Greenwood county, Kansas
Feb. 17	5	Half term	Greenwood county, Kansas
Feb. 25	5	Large	Greenwood county, Kansas
Feb. 28	6		Douglas county, Kansas
Mar. 7	3		Greenwood county, Kansas
Mar. 15	5	One-third term	Greenwood county, Kansas
Mar. 18	5	Large	Greenwood county, Kansas
June 17	3	2.0 mm	Meade county, Kansas
June 17	2	10.0 and 4.0 mm	Meade county, Kansas
June 18	4	1.0 mm	Meade county, Kansas
June 18	3	Very small	Meade county, Kansas
June 18	2	38.0 mm	Meade county, Kansas
July 11	1	Full term	Meade county, Kansas
July 11	1	30.0 mm	Meade county, Kansas
July 11	5	25.0 mm	Meade county, Kansas
July 11	3	20.0 mm	Meade county, Kansas
Dec. 21	5	Two-thirds term	Greenwood county, Kansas
Dec. 23	4	Nearly full term	Douglas county, Kansas

nebrascensis. Cuttings and feces of *Synaptomys* were observed in the heavy growths of the large sedge (*Scirpus olneyi* Gray).

The habitat in which the *Microtus* were found is interesting. They were found on a rather dry area within a bog. The bog area is approximately 8 acres. The bog is located on the south side of Crooked Creek within the Crooked Creek valley near a point where the land gently rises toward the east. It is produced by deep-seated artesian springs which break through to the surface at this place. Due to the large amount of accumulated decayed vegetation the water seeps through at numerous places and no one place now offers a heavy flow. The following history of the bog is that given by Henry Hildebrand. At the time his family moved on to the place a small area of the bog (the highest part of land) had been drained by cutting lateral ditches around an area which allowed the seepage to enter the ditches. This area was approximately 200 feet long and nearly 100 feet wide. It had been placed under cultivation for raising garden vegetables. In 1925 Mr. Hildebrand began to ditch the entire bog area which was finished approximately during 1932, and he was able to confine the seepage and small flows to the ditches. They were so constructed that there were two large ones running parallel with numerous lateral ditches which ran out at right angles from the two main ditches. The bog was then placed under cultiva-

tion and truck farming was carried on in the area until 1938. During this entire time sedges were abundant along the ditches. In the summer of 1934 in burning off the trash the dried out bog material caught fire and one small area burned to a depth of at least one foot. Peat meadows were recognized in this area as early as 1878, for prior to this date peat had been dug and found to burn readily (First Biennial Report, Kansas State Board of Agriculture, p. 466, 1878). The fire smouldered for better than two weeks. It appears to have burned down to ground water level as this area now is covered chiefly by water and the tall sedge (*Scirpus validus* Vahl.). It is almost impossible to work one's way across this area since the burning of the peat has allowed the water table to rise. It was in this area that we found a nest of the western yellow-throat warbler and also observed numerous nests of the redwinged black-bird and yellow-headed black-bird. Bluewinged teal were observed and a king rail was heard calling. The bog has not been cultivated since 1938, which allowed the drainage ditches to become choked with vegetation and most of the area has reverted back to the original bog with the exception of the one high point which was first placed under cultivation. This area is rather dry and was thickly covered with foxtail barley in which were numerous runs of *Microtus*. The runs crossed many times and always led to the sedges growing along the area in the moist soil. It was in the sedges that their underground runs were found; two were found in the foxtail barley, but only one showed signs of habitation. It was impossible for *Microtus* to inhabit the area when it was under cultivation.

Bordering the bog is approximately a 60 acre plot of tall grass which was used as meadowland until 1937 when it was turned over to pasture. It has been grazed rather short and *Microtus* in this area would have been crowded into surrounding areas that would afford suitable cover and food, which may account for the large population observed when trapping. If the tall grass is the usual home of the *Microtus* in Meade county the population must be small and confined to rather isolated areas, since many acres of meadowland along Crooked Creek valley had been searched for signs of them in the past six summers.

Time was not available this past summer for the examination of surrounding meadowland or other bogs along Crooked Creek for the presence of *Microtus*, though it is definitely known that they do not occur in the Meade County State Park either in the extensive meadowland or in the bogs. In the Park are extensive areas of fox-

tail barley (*Hordeum jubatum)* which seem to offer a perfect habitat and are only inhabited by *Scalopus aquaticus intermedius* (Elliot), *Cryptotis p. parva, Reithrodontomys megalotis aztecus, Peromyscus maniculatus* cf. *nebrascensis* and *Sigmodon hispidus texianus* (Audubon and Bachman). This condition may be due to the fact that the park area is isolated from the Crooked Creek valley by a long stretch of sage brush and short grass. It seems that they should have been in the area before the building of the State Lake and the destruction of the habitat that existed along the tributary that ran into Crooked Creek.

The hot dry summers of the past eight years may have played an important part in their present distribution since the mammals of that area were not studied until after the peak of the development of the dust bowl. Dice (1922, p. 46) found that temperatures in excess of 98° F. were fatal to *Microtus ochrogaster* taken near Urbana, Illinois. If *M. o. taylori* is also affected by excess heat, it would account for the scarcity of the individuals in Meade county, and only those that were able to survive the drought would have found escape around suitable bog areas. Competition around these small oases must have been great during the peak of the drought. During the drought of 1936 we trapped areas in Meade county which appeared identical with the area trapped in Rawlins county, Kansas, that same summer where specimens of *M. o. haydenii* were obtained. The data at hand show clearly that *M. o. taylori* inhabits a much more moist habitat than *M. o. haydenii.*

Most of the meadows that would have furnished a suitable habitat for *Microtus* along Crooked Creek have been destroyed since the first settlement in 1877 in that valley. At the time of the settlement of Meade county extensive meadows and bogs occurred along Crooked Creek from a point approximately 4 miles south of Meade to a few miles upstream above Fowler, Kansas; at which time it was possible to go from Meade, Kansas, up Crooked Creek by boat to Fowler, Kansas. Draining of the area for agricultural purposes has destroyed these extensive meadows and bodies of water that existed in this area.

Ten of the females of *M. o. taylori* taken from the bog area contained embryos. The smallest female found to contain embryos had a total body length of 153 mm. For data concerning size and number of embryos see Table II.

Discussion. For the known distribution of *Microtus ochrogaster* in Kansas see map, fig. 5. All localities shown on the map are taken from Museum specimens except the following by Bailey (1900, pp.

74-75), Cairo, Onaga, Burlington, Pendennis and Banner, Kansas; Dice (1923, p. 48) Manhattan, Kansas, and Wooster (1938, p. 515) Hays, Kansas.

From the material available for study it is impossible to show areas of intergradation or the extent of the ranges of the subspecies within the state.

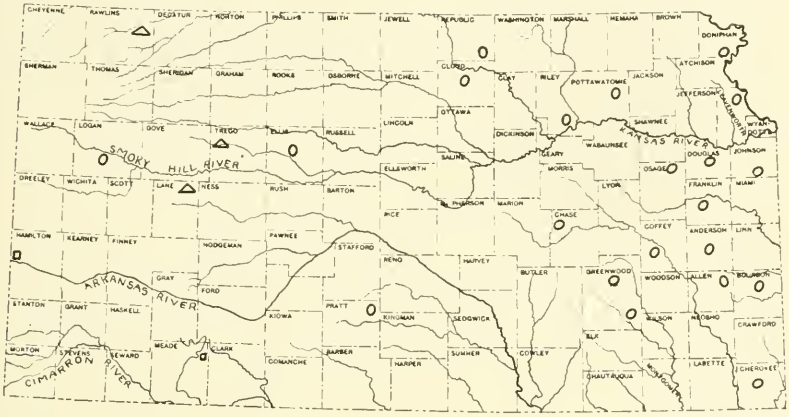

FIG. 5. Map of Kansas showing distribution of the subspecies of *Microtus ochrogaster* subsp.?. △, *Microtus ochrogaster haydenii* (Baird). □, *Microtus ochrogaster taylori* subsp. nov. ○, *Microtus ochrogaster* (Wagner).

Microtus o. taylori should be found throughout southwestern Kansas where suitable habitats exist. Whether the cranial difference, that is, the development of the rostral ridge, is due to an isolated stock is unknown but it is a common character of the Meade county specimens and separates them sharply from specimens of the same or larger size from Hamilton county, Kansas and Woods county, Oklahoma.

In the collection of fossils there are three fragmentary lower rami containing M_1 and M_2; two rami are from the Pleistocene of Meade county that are referred to *Microtus ochrogaster*.

Joe Tihen collected a fragmentary left ramus, No. 5971 KUMVP, bearing M_1-M_2 of an old adult from an eroded valley or sink hole fill along a tributary on the north side of Cimarron river on the XI Ranch, Meade county, Kansas, summer of 1940. The deposit from which the specimen was taken is considerably younger in age than the high terrace deposits at this locality. In the deposit are numerous snails and *Sphaerium*. In age it is very late Pleistocene or early Recent. The dentition compares well with that of the Recent

Microtus ochrogaster from Meade county though the M_1-M_2 series is slightly larger having an anteroposterior diameter of 5.25 mm., approximately the anteroposterior diameter of *Pitymys mcnowni* Hibbard from the Pleistocene of northeastern Kansas. Even though *P. mcnowni* possesses reëntrant angles of the same shape as those of *Pitymys*, it may prove, when sufficient material is at hand, to be a large form of *M. ochrogaster*.

A right ramus, No. 5191 KUMVP, containing M_1 and M_2, was taken from Locality No. 13, Meade county, Kansas, associated with the Jones Fauna. The anteroposterior diameter of M_1 and M_2 is 4.25 mm.

Another specimen of fossil *Microtus ochrogaster*, No. 6289 KUMVP, a fragmentary left ramus bearing M_1-M_2, comes from an older Pleistocene deposit in Lincoln county, Kansas, Locality No. 5. This specimen is intermediate in size between *Microtus ochrogaster* now found living in Kansas and *Microtus o. minor* (Merriam). We have been unable to compare the ramus with those of intermediate forms between the two subspecies. The anteroposterior diameter of M_1-M_2 in the fossil form is 4.4 mm. while the same diameter in the type of *M. o. taylori* is 4.6 mm. The reëntrant angles and closed triangles of this specimen appear more like those of *Pedomys* than those of *Pitymys*. The characters of these dentitional patterns are not sufficient to separate the fossil jaws from the subgenus *Pedomys* or the genus *Pitymys* with certainty.

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Mexican Lizards of the Genus *Eumeces*, with Comments on the Recent Literature on the Genus

By EDWARD H. TAYLOR,
Department of Zoölogy, University of Kansas

ABSTRACT: This paper deals with some 300 specimens of Mexican *Eumeces* (Family SCINCIDAE), belonging to 14 species. It reviews the known distribution of all the Mexican species. Recent progress in the study of the genus is reported, and the recent literature is listed.

NOWHERE in the world is there as great a concentration of species belonging to the genus *Eumeces* as occurs in México. More than one-third of the known forms are to be found there, and nine of the fifteen groups are represented. At the time of the publication of my monograph (Taylor 1936), many of the Mexican forms were known from inadequate series, several from single specimens. Since the completion of that work, I have obtained a large collection of *Eumeces* from México, including the following species: *Eumeces schwartzei, altamirani, lynxe lynxe, lynxe furcirostris, tetragramus, brevilineatus, callicephalus, parviauriculatus, copei, brevirostris, indubitus, dugesii, dicei, ochoterenae.* Aside from this series of fourteen species, *Eumeces parvulus* was rediscovered in Colima by Dr. James A. Oliver (1937); Dr. Hobart M. Smith* obtained specimens of *Eumeces sumichrasti* in Chiapas and Guatemala.

Mr. L. M. Klauber obtained *Eumeces gilberti rubricaudatus* from North Coronado Island, Baja California. To my knowledge no specimens of *Eumeces obsoletus, humilis, colimensis, lagunensis,* or *skiltonianus skiltonianus* have been collected in México since 1935.

* Dr. Hobart M. Smith has been of very much assistance in the preparation of this paper. He has read and criticized the work, and has supplied numerous bibliographical references. I express my appreciation to him for his help.

This series of Mexican forms may be arranged as follows in the groups proposed by Taylor (1936, p. 35):

schwartzei group	*Eumeces schwartzei* Fisher *Eumeces altamirani* Dugès
lynxe group	*Eumeces lynxe lynxe* (Wiegmann) *Eumeces lynxe fureirostris* (Cope)
sumichrasti group	*Eumeces sumichrasti* (Cope)
brevilineatus group	*Eumeces brevilineatus* Cope *Eumeces callicephalus* Bocourt *Eumeces tetragrammus* (Baird)
obsoletus group	*Eumeces obsoletus* (Baird and Girard)
multivirgatus group	*Eumeces humilis* Boulenger *Eumeces parvulus* Taylor *Eumeces parviauriculatus* Taylor
anturacinus group	*Eumeces copei* Taylor
skiltonianus group	*Eumeces skiltonianus skiltonianus* (Baird and Girard) *Eumeces gilberti rubricaudatus* Taylor *Eumeces lagunensis* Van Denburgh
brevirostris group	*Eumeces brevirostris* (Günther) *Eumeces indubitus* Taylor *Eumeces dugesii* Thominot *Eumeces colimensis* Taylor *Eumeces dicei* Ruthven and Gaige *Eumeces ochotcrenae* Taylor

The *brevirostris* and *skiltonianus* groups are probably connected by *Eumeces lagunensis*. It has the characteristic temporal arrangement of the former but the red tail suggests a relationship with *gilberti rubricaudata* of the latter group.

Eumeces schwartzei Fischer

Eumeces schwartzei Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 94-102, pl. 1, text figs. 5-6, (synonymy); Smith, Occ. Papers Mus. Zoöl., Univ. Michigan, No. 338, Oct. 31, 1938, p. 17 (Campeche).

Dr. Hobart M. Smith in 1936 obtained two specimens of this striking species in Campeche: one, (EHT-HMS No. 11511) at Tres Brazos and the other (No. 11512) at Encarnación. Both are typical as regards color pattern and squamation.

No. 11511. In this specimen the median dorsal scales between the parietals and a point above the anus are arranged as follows: nuchals, 4 left, 5 right, followed by 11 pairs of broadened scales; these in turn are followed by 41 broad single median scales, after which there are five paired scales. There are three presuboculars and four postsuboculars, a postnasal, eight upper labials, 3-4 strongly-defined ear lobules. The frontoparietal touches the frontal and the parietals are separated narrowly behind the interparietal. The primary temporal is in contact with the lower posterior temporal, the latter hav-

ing an area about equal to the eighth labial. 21 scales around the middle of the body, 26 about the neck.

No. 11512. In this specimen the 5½ pairs of nuchals are followed by 9-10 paired scales, and 45 widened median scales. From the last scale to the point above the anus there are three pairs of scales. The labials, presuboculars, temporals, internasal, frontonasal, and scale rows, are the same as in the preceding specimen. The postsuboculars are 4-3, and the auricular lobules are 3-3. The dots on the ventral scales of No. 11511 tend to form more or less distinct lines, while in No. 11512 the ventral scales are almost lacking in dots.

Doctor Smith has more recently taken two specimens at Tenosique, Tabasco, and four at Piedras Negras, Petén, Guatemala, near the Chiapas border, and very probably it will be taken sooner or later in Chiapas. In México it is known to occur in Campeche and Yucatán; in Central America, in Guatemala and British Honduras.

Eumeces altamirani Dugès

Eumeces altamirani Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 102-104, pl. 2, text fig. 6; and Proc. Biol. Soc. Washington, 49, May 1, 1936, pp. 55-58.

The type, together with the four specimens (EHT-HMS, Nos. 10230-10233) collected by Dr. Hobart M. Smith at El Sabino, Michoacán (reported in detail by Taylor, May 1936, *loc. cit.*), constitute the only known specimens of this rare species. However, the characters that obtain leave no doubt as to its complete distinctness from other species of the genus. The form is not known to occur outside of the state of Michoacán.

Eumeces lynxe lynxe (Wiegmann)

Eumeces lynxe lynxe Taylor, Univ. Kansas Sci. Bull. 23, No. 1, 1935 (Aug. 15, 1936), pp. 163-173, pl. 41, fig. B; text figs. 18, (map), 19, (squamation of head) (synonymy).

In my previous treatment of this form (*loc. cit.*) I was in doubt as to the geographic location of the type locality. I am now of the opinion that the "Chico" mentioned by Wiegmann is El Chico, or Mineral del Chico, near Pachuca, Hidalgo. I have found the species to be common in this general region (El Chico National Park).

I was somewhat in doubt as to the value of the subspecies, *Eumeces lynxe furcirostris* (Cope), and stated that its recognition depended upon an accumulation of more material. Since that time I have obtained some 59 specimens of *E. lynxe* from various localities in Hidalgo, Veracruz and Puebla, and find that the eastern populations have a much reduced anterior supraocular which is usually separated from the frontal.

Of the 59, I regard 35 as being *Eumeces lynxe lynxe* (Wiegmann). These are from the following localities in Hidalgo: EHT-HMS Nos. 16234-16255, between Minas Viejas and Durango; 19113, El Chico National Park; 19114-19116 Guerrero; 19117, south of Zacualtipan; 19118, near Tienguistengo; 22220-22223, Durango; 23910-23912, 8 km. south of Tianguistengo; 23913, El Chico.

The largest specimen, typical in every way, measured 70 mm. from snout to vent, while the tail measured 102 mm. Four supraoculars are present in 34 specimens, three only are present in one. There are three supraoculars in contact with the frontal in 27 cases; 3 on one side, 2 on the other in 4 cases; and five cases in which there are 2 only on each side of the frontal. The scale rows around the middle of the body are 24 in 25 specimens; 23 in 4, 22 in 4, and in one 26. In two specimens having perfect tails the subcaudal scale counts are 85 and 86. In 16 specimens the prefrontals are separated; in 18 they are in contact. One specimen has a third (median) prefrontal.

The subspecies is known from the following Mexican States: Hidalgo, Veracruz, San Luis Potosí and northern Puebla. The old records of the species in Michoacán, Guerrero, and Guanajuato must be verified before being accepted.

Eumeces lynxe furcirostris (Cope)

Eumeces lynxe furcirostris Taylor, Univ. Kansas Sci. Bull., 23, No. I, 1935 (Aug. 15, 1936), pp. 173-178, text figs. 18, 20 (see this work for synonymy).

Specimen of *lynxe* from Veracruz are interpreted as belonging to the subspecies *furcirostris* or as representing intergrades between *lynxe lynxe* and *lynxe furcirostris*. The anterior supraocular is reduced or wanting (that is, fused with the anterior supraciliary). In the greater part of the specimens there are but two supraoculars in contact with the frontal.

The following 24 specimens have been added to the collection: EHT-HMS Nos. 19109-19112 A, Cofre de Perote, Veracruz; 28809-28810, km. 291-292 near Las Vigas, Veracruz; 28835-28843 between La Joya and Las Vigas, Veracruz; 28827-28834, near Tezuitlán, near Puebla-Veracruz state line (perhaps from both states).

In these, four supraoculars occur 15 times; four on one side, three on the other, 5 times; and three, 4 times. In these, 15 have only two supraoculars touching the frontal, while 8 have three; 20 have 24 scale rows about the middle of the body, 2 have 25 rows, one has 26. Subcaudal counts for three specimens having complete tails are 80, 81, 84. The prefrontals are in contact 14 times, and separated 10

times. This form is known from eastern Veracruz and western Puebla.

The characters by which the two forms may be separated are as follows:

A. 4 supraoculars, three touching the frontal; the first not reduced or fused to the first supraciliary ..... *l. lynxe.*
B. 4 or 3 supraoculars, two touching frontal, the first reduced or fused to supraciliary ..... *l. furcirostris.*

It would appear from the above data that of this lot of *furcirostris* only 67 percent are identifiable on the basis of the supraocular character. However, it is probable that certain specimens are intergrades and should be excluded from the computation of the percentages. It may be pointed out that the specimens are from a relatively limited area and it is likely that collections made farther to the east and southeast would show a higher percentages of differentiation with fewer forms displaying intergrading characters. I am not prepared to abandon the name *furcirostris* for this population, until this possibility is disproved.

Eumeces sumichrasti Cope

Eumeces sumichrasti Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 178-186, pl. 12, text figs. 21, 23 (synonymy).

Dr. Hobart M. Smith found this species to occur rather commonly in Chiapas, and the closely adjoining region of Guatemala. He supplies the following localities: Palenque, Chiapas (3 spec.); La Esperanza, Chiapas (4 spec.); and Piedras Negras, Petén, Guatemala (4 spec.). These specimens, now in the United States National Museum, have not been examined by me.

The species is known from the Mexican states of Veracruz, Chiapas. In Central America, it is known from Guatemala, Honduras, and British Honduras. It is a lowland form for the most part.

Eumeces callicephalus Bocourt

Eumeces callicephalus Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 290-298, pl. 23, text figs. 44-45; Proc. Biol. Soc. Washington, 49, May 1, 1936, pp. 55-58 (Magdalena, Jalisco); Taylor and Knobloch, Proc. Biol. Soc. Washington, 53, Oct. 7, 1940, p. 127 (Sierra Madre Mountains [Mojárachic] Chihuahua).

The specimens EHT-HMS Nos. 10392-10395 from Magdalena, Jalisco, reported by Taylor (1936), and No. 23109, from Mojárachic, Chihuahua, reported by Taylor and Knobloch (1940) *loc. cit.* are apparently the only recent collections of this form. However, this species is well known, and established on a sound basis.

The species is known in México from Chihuahua, Durango, Zacatecas, Guanajuato, Nayarit and Michoacán (the record for the last state needs to be verified). It also occurs in Arizona.

Eumeces brevilineatus Cope

Eumeces brevilineatus Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 283-290, pl. 22, text figs. 41, 42, 43.

This species is represented in the recent collections by a young specimen taken in the palm forests 26 km. north of El Limón, Tamaulipas (km. 609) (EHT-HMS No. 14497). In this the dorsolateral lines are reddish orange anteriorly, becoming more yellowish posteriorly, and terminating before the middle of the body is reached. The tail is blue, the body deep black. The edges of the lips and throat are red orange, while the chin is whitish. The posterior part of the abdomen is blackish, the anterior greenish white.

In México the species is known from Nuevo León, and Tamaulipas. It is widely distributed in southern Texas.

Eumeces tetragrammus (Baird)

Eumeces tetragrammus Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 298-304, fig. 46, distribution (synonymy).

I collected a specimen of this rare form 3½ miles west of El Forlón, Tamaulipas (EHT-HMS 10390), and two specimens south of Antiguo Morelos, No. 10391 at km. 516, and No. 29684, at km. 532 both in the state of San Luis Potosí.

No. 29684 is an adult male. However, the dorsolateral lines can be seen to the base of the tail, and the underside of the tail is somewhat bluish. The chin and throat are white, the color extending, and including all save the upper edge of the upper labials. The following characters obtain: Frontonasal separated from frontal; interparietal not enclosed; two pairs of nuchals; lower secondary temporal larger than primary; tertiary temporal large, separated by two scales from the auricular opening; seventh labial followed by two pairs of large, and one pair of small postlabials; auricular lobules two or three, small; 28 scale rows around middle of body 30 around narrow part of neck; 1 postmental; 60 scales from parietals to above anus; 106 widened subcaudals under complete tail. Snout to vent, 63 mm.; tail, 109. The adpressed limbs touch.

In both Nos. 10390, 10391, the dorsolateral lines continue on base of tail, while the lateral line can be traced a similar distance. They have 26 and 28 scales, respectively; the nuchals are 3-1, and 3-3. Length snout to vent, 70 mm. and 53, respectively. In most of the other scale characters they conform to the preceding specimen.

Eumeces obsoletus Baird and Girard

Eumeces obsoletus Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 305-320 pl. 24; text figs. 47-48 (synonymy and monographic treatment).

This species, widely distributed in the United States, is known in México from the states of Tamaulipas, Nuevo León and Chihuahua. No recently collected specimens have been seen.

Eumeces humilis Boulenger

Eumeces humilis Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 358-363 (part.), fig. 59.

Smith has recently reviewed the specimens referred by Taylor (*loc. cit.*) to the species *Eumeces humilis*, and believes the northern specimens from Texas and New Mexico are separable on the basis of two postmentals, widened subcaudals and the absence of dorsolateral light lines. Both Mosauer (1932) and Taylor (1936) are in error in stating that the Texas specimens have an undivided postmental as is true of *humilis*.

The species is therefore known only from the types; and its known distribution is the type locality, Presidio, [presumably] Sinaloa, México.

Eumeces parvulus Taylor

Eumeces parvulus Taylor, Proc. Biol. Soc. Washington, 46, Oct. 26, 1933, pp. 175-178, fig. 1 (Type description; type locality, Tepic, Nayarit, México); and Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 363-367, pl. 31, figs. 3, 4; text figs. 59, 60; Oliver, Occ. Papers Mus. Zoöl., Univ. Michigan, No. 360, Nov. 20, 1937, p. 12 (Paso del Río, Colima).

Since the description of this small species appeared, originally based on three specimens, only a single specimen has been reported, this by James A. Oliver, who obtained it at Paso del Río, Colima. He reported that it differed from the type in having a larger posterior loreal and a smaller anterior one, while the median scale rows appeared to be slightly larger.

In México the species is known from Colima, Nayarit and Sinaloa.

Eumeces parviauriculatus Taylor

Eumeces parviauriculatus Taylor, Proc. Biol. Soc. Washington, 46, Oct. 26, 1933, pp. 178-181, fig. 2 (type description; type locality, Alamos, Sonora); Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 368-371, pl. 31, fig. 5; text figs. 59-61; Taylor and Knobloch, Proc. Biol. Soc. Washington, 53, Oct. 7, 1940, pp. 128 (Mojárachic, Chihuahua).

Only three specimens of this diminutive species have been discovered; the type, and two specimens reported by Taylor and Knobloch (1940).* The latter specimens extend the known range to

* All the specimens reported in Taylor and Knobloch (1940) were obtained in a radius of ten miles from Mojárachic, Chihuahua, unless otherwise stated.

the north and west of the type locality to Mojárachic, Chihuahua, a distance of about 75 miles.

One of the two specimens, (EHT-HMS, No. 18983), lacks a head and while I believe it to be the same species, there is no absolute certainty. It is young and exceedingly slender. A complete tail is present, showing 98 widened subcaudals.

This species appears to be well-characterized by the greatly enlarged lower secondary temporal, much larger than the seventh supralabial, the small ear, and scale rows which number 20.

It is only known from southern Sonora and western Chihuahua.

Eumeces copei Taylor

Eumeces copei Taylor, Proc. Biol. Soc. Washington, Vol. 46, June 30, 1933, pp. 133-137 (type description; type locality 10 miles southeast of Asunción, western México); and Univ. Kansas Sci. Bull., Vol. 23, 1935, Aug. 1936, pp. 387-394, pl. 33. Text figs. 64, 65.

This species proves to be a common one in a limited region in the southern part of the Mexican plateau. It is an isolated member of the *anthracinus* group, its nearest relative *septentrionalis obtusirostris,* being separated, presumably, by a distance equal to that between México (city) and Texas.

The following specimens have been added to the collection; EHT-HMS coll. Nos. 10256-10269, 19000-19065, 22230, 26212-26214, near Lake Zempoala (Cempoala), Morelos; Nos. 19066-19074, mountains west of Río Frío, México, between 9,000 to 10,000 feet elevation; Nos. 19075, 8 miles west of Villa Victoria, Sept. 1, 1938; 19076, 3 miles west of Zinacantepec (Zinganzantepec) México; 19078, 9 miles west of Zacapú, near Cerro de Tecolote, Michoacán; Nos. 22227-22229, 22230-22235, 22589-22600, near Río Frío, México, (a few from these series were obtained east of the town, in the state of Puebla.

These acquisitions bring the total number of specimens of this species up to 75. The range has been extended somewhat, and it is now known from Eastern Puebla, México, Distrito Federal, Morelos, and Michoacán.

All the specimens hold to the typical color markings with a remarkable tenacity. This pattern consists of a broad black lateral band on which are two sharply defined, narrow, white or cream-white lines. The primary temporal and the lower secondary temporal are similar in size and are almost invariably in contact. There are narrow, dark brown stripes on the back, which may become obsolete in old males; however, the dark lateral stripe and the narrow light lines are not lost.

The habitat of the species is the same as that of *Eumeces indubitus,* both reaching an elevation of 10,000 to 11,000 feet, and probably not occurring lower than 7,000 feet.

Eumeces skiltonianus skiltonianus (Baird and Girard)

Eumeces skiltonianus skiltonianus Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 415-428, pls. 35-36, figs. 2, 3, 4; text fig. 68.

The species occurs at sea level on the Todos Santos and Coronados Islands and on the mainland of Baja California at elevations up to 7,500 feet. Further study of these and other specimens of the United States may warrant the separation of other subspecific forms.

In México, it is known only from northern Baja California. It is widely distributed in western United States, its range extending into Canada.

Eumeces lagunensis Van Denburgh

Eumeces lagunensis Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1935), pp. 431-437, pl. 36, fig. 1; text figs. 69-70.

This form is known to occur only in the southern part of Baja California. The character of the temporal scales of this species would seem to ally the *skiltonianus* group with the *brevirostris* group. The form might be associated equally well with either.

Eumeces gilberti rubricaudatus Taylor

Eumeces gilberti rubricaudatus Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 446-451, pl. 39, text figs. 72-73. (Type description.)

In a letter dated August 24, 1936, Mr. L. M. Klauber writes to me that he had obtained two specimens of *Eumeces gilberti rubricaudatus* from North Coronado Island, Baja California. Both had "very bright red tails."

Eumeces colimensis Taylor

Eumeces colimensis Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 478-485, pl. 40, fig. 3; text figs. 76, 80.

This species, well-differentiated from all Mexican forms by the strongly developed limbs, overlapping in the adult, the length of the foot, is still known only from Colima, México, the type locality.

Eumeces indubitus Taylor

Eumeces indubitus Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 466-472, pl. 42; text figs. 76, 78 (synonymy).

Specimens of this species mentioned by field numbers in Taylor (1936 *loc. cit.*), 1671, 1673, 1674, 1696, 1722, 1723, 1725, 1726, 1727, 1728, 1729, 3595, are now EHT-HMS Nos. 10318-10329 respectively.

All are from the region about km. 63, between Cuernavaca and Tres Cumbres (Tres Marias) except the last, which is from near Asunción, México. Nos. 3587, 3588, 3590, 3591, 3594, 3596, 3597, 3598, 3599, 3600, 3601, 3592, 3593 are 10344-10356 respectively, from near Asunción, México; No. 1697 is 10357 from 5 km. south of Tres Cumbres, Morelos.

The following have been collected since the completion of the monograph: EHT-HMS Nos. 10332-10343, between kms. 58 and 66, between Cuernavaca and Tres Cumbres (Tres Marias), Morelos; Nos. 22224-22225, near Tepoztlán, Mor.; No. 23898, Zempoala, Mor.; No. 19085, Huajintlán, Mor.; and 19089, Puerto Hondo, Michoacán.

This species may be distinguished by the enclosed parietal, and the short, labial, light line which does not normally extend beyond the auricular opening. However, two young specimens, Nos. 19085 and 19089, have the labial line extending a little beyond the ear.

The form is known from Morelos, México, and Michoacán, sharing this range with *Eumeces copei.*

Eumeces brevirostris (Günther)

Eumeces brevirostris Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 459-466, pl. 41; text figs. 76, 77 (synonymy).

The following represent acquisitions of this species since 1935: EHT-HMS Nos. 10379-10382, 19086, 28844-28846, Totalco, Veracruz; Nos. 19088, 23903-23906, Cerro San Felipe, Oaxaca, Oaxaca; Nos. 23916-23918, 23920, 23931, Omilteme, Guerrero; No. 27469, San José Lachiguiuri, Oaxaca; Nos. 28811, 28812, near Laguna San Bernardino (near Puebla-Veracruz border), probably in Veracruz; Nos. 28813-28817, east of Río, Frío, (México) in Puebla; Nos. 28818-28826, near El Seco, Puebla (Km. 205 on highway).

The present accepted range of this form is remarkable. It occurs in Puebla, Vera Cruz, Oaxaca, Guerrero, Michoacán, Jalisco, and Durango, a range almost surrounding the area in which occurs *Eumeces lynxe, copei, dugesi,* and *indubitus.*

Eumeces ochoterenae Taylor

Eumeces ochoterenae Taylor, Proc. Biol. Soc. Washington, 46, June 30, 1933, pp. 129-133 (type description; type locality, Mazatlán, Guerrero actually 22 km. by highway south of Chilpancingo); and Univ. Kansas Sci. Bull. 23, 1935 (Aug. 15, 1936), pp. 485-489, pl. 43; text figs. 76, 82.

The original series of eleven specimens has been augmented by the addition of 25 more, all collected in the central part of the State of Guerrero. These latter specimens are from the following localities:

EHT-HMS Nos. 19079-19080, Agua del Obispo, July 6, 1938; 22226, 7 mi. east of Chilpancingo, July 1939; 23899-23902, Agua del Obispo, Aug. 1940; 23932, Mazatlán, (22 km. by highway south of Chilpancingo. Not "4 miles north" as stated by Taylor "Eumeces" p. 485, and 489, and in type description); 23933-23947, Vicinity of Chilpancingo, chiefly, about 4 miles north, Aug. 1940.

None of the listed specimens exceed 53 mm. snout-to-vent measurement. So I presume the type (the largest specimen of the type series) is probably very near to the maximum size of the species (56 mm.).

I find no significant variation in color pattern. The blue color of the tail, normally lost in the adult of many species, has not been lost in any of the specimens collected.

Twenty-two scale rows about the middle body is probably normal but if count is made somewhat farther forward there will be 24. Occasionally the extra row extends back to the middle on one side or the other, resulting in a count of 23 or 24. I have found a single postmental, 2 pairs of nuchals, no postnasal, and seven upper labials to be invariable. In five cases the frontonasal was in contact with the frontal, while in two cases the parietals enclosed the interparietal. The greatest variation obtains in the temporal region. The anterior temporal varies considerably in size and may be absent altogether, that is, fused to an adjoining scale, usually the upper primary temporal. This condition occurs in two specimens. The primary temporal is in contact with the lower secondary temporal 22 times out of 46; the seventh upper labial touches the upper secondary temporal 24 times out of 46, consequently it is difficult to determine which is to be regarded the "normal" condition of temporal scutes.

The species is known only from Guerrero, México.

Eumeces dugesii Thominot

Eumeces dugesii Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 472-478, pl. 43; text figs. 76, (map), 79, (squamation). See this work for synonymy.

Two specimens of this species, which I obtained in Michoacán, one (No. 19081) Sept. 7, 1938, 9 miles west of Zacapú, Michoacán, near Cerro de Tecolote, and a young one (No. 29691) Aug. 16, 1942, on the Uruapan road near Carapa (km. 7), add nothing to the known distribution of this form.

No. 19081. The dorsal surface is uniform light bronze. It is bordered laterally by a moderately distinct, cream line, that follows the third scale row to the base of the tail and is thus separated from

its fellow by four rows of wide dorsal scales. The light labial line is separated from the labial edge by a darker stripe and continues back through the ear to a point behind the arm. The brown lateral stripe is distinct, covering two whole scale rows and edges of the two adjoining rows.

Three characteristic supraocular scales are present, the anterior very large, touching the prefrontal; and six superciliaries, the first large, but separated from contact with frontal, while the small interparietal is completely enclosed behind by parietals. The anterior temporal, normally small, is greatly reduced on the right side. The two postlabials and the tertiary temporal are relatively large. The scale rows are 22 at midbody and 26 about the neck. There are 62 scales intervening between the parietals and a point above the anus. There are 12 lamellae under the fourth toe, and the adpressed limbs are separated by 9 scales.

No. 29691. There are 24 scale rows about the body, 26 about neck. Three supraoculars are present, two touching the frontal. The interparietal is enclosed by the parietals, and the frontonasal is broadly in contact with the frontal. The primary temporal is absent, fused to the upper secondary. The adpressed limbs overlap. The snout to vent length is 33 mm. The dorsolateral white stripe can be traced on the anterior third of the body; while the labial line which passes through the lower part of the ear can be traced to a point a short distance behind the arm.

This species is known certainly only from Guanajuato and Michoacán.

Eumeces dicei Ruthven and Gaige

Eumeces dicei Ruthven and Gaige, Occ. Papers Mus. Zoöl., Univ. Michigan, No. 260, Apr. 3, 1933, pp. 1-3 (type description; type locality, Marmolejo, Tamaulipas, México); Taylor, Univ. Kansas Sci. Bull., 23, No. 1, 1935 (Aug. 15, 1936), pp. 482-485, figs. 76 (map), 81 (head squamation); Dunn, Acad. Nat. Sci., Philadelphia, 88, 1936, Oct. 20, 1936, p. 476 ("Cieneguillas" south of Galeana, Nueva León, 3 specimens; above Pablillo, 8200 ft., Nuevo León, one specimen (the El Salto, Durango specimen belongs to another species).

The species was originally founded on a single individual; this an immature specimen, 47 mm., snout-to-vent measurement. I have examined eight more specimens and seven embryos of this species. A study of these specimens establishes the species on a sound basis, and gives more certainty as to its relationships. I had presumed the adult to be smaller than is actually the case, and I pointed out certain similarities to *Eumeces egregius*. However, I do not now believe them to be related, save remotely.

The relationship is certainly with the *brevirostris* group. The anterior temporal is normally absent, but there is normally present

a very reduced lower secondary temporal (fused to the seventh labial or the tertiary temporal in the type).

The scales about the ear opening average about 15 or 16, while in the type the number counted was eleven, suggesting a somewhat smaller ear opening or slightly larger scales. The interparietal is broad, slightly truncate behind, and is never enclosed by the parietals (16 cases). The frontonasal is normally separated from the frontal, but in three cases they are in contact, the prefrontals being consequently separated. The presence of two nuchals, a single postmental, no postnasal, two presuboculars, four supraoculars, internasals in contact and frontoparietals in contact, appear to be constant characters. Three supraoculars touching the frontal is normal, yet a single specimen shows only the two middle ones so arranged.

The scales on the sides of the body are perhaps a little smaller than the dorsal rows, but in females with bodies distended with eggs or embryos, they appear to be nearly the same size. The subcaudal scales are much widened, the number (in two complete counts) being 74, and 76. The scale rows around the middle of the body are 22-(24) while at axilla the rows are above 30 in number. The minimum number about the neck varies between 24 and 26, the latter number being more common, the smaller number occurring but once. The scales from the parietals to the point above the anus average about 60, varying between 56 and 62, the larger numbers being in females. The sixth labial approaches or equals the last (seventh) labial in size. The small scale following the seventh labial, and (usually bordering the auricular opening), is not to be considered a labial scale.

The adpressed limbs are separated from each other by 10-14 scales in females; 5 to 7 in males, in adult and subadult specimens. In very young specimens the limbs touch, or slightly overlap.

The species is ovoviviparous. Of the three adult specimens in my collection from Pablillo, Nuevo León, collected by H. Radcliffe Roberts, one contains three embryos; another, one embryo and an egg mass showing no trace of an embryo; a third has four embryos, three of which appear nearly ready for birth; the fourth, with a large mass of yolk is apparently a very much younger embryo. A young specimen, 25 mm., snout-to-vent, was taken at the same time.

I have been enabled to study the four specimens in the Academy of Natural Sciences of Philadelphia, thanks to the courtesy of Charles M. B. Cadwallader, President of that Institution.

Known only from Nuevo León and Tamaulipas in México.

Since the publication of the Taylor (1936) monograph on the genus *Eumeces*, a rather considerable literature has appeared dealing with the genus. This includes new and important distributional data; the descriptions of new forms; habits; and usage and comments on the taxonomy. I note herewith certain of these, and add certain corrigienda on the Taylor work.

DISTRIBUTIONAL DATA

The following are some distributional data of importance: *Eumeces obsoletus* has been traced into Missouri by Paul Anderson (1942); Anita Daugherty (1942) reports specimens of *Eumeces multivirgatus from* Topock, Mohave county, Arizona, the westernmost record. *Eumeces egregius* is reported from Alabama by Carl P. Kauffeld (1941) and from west of Atlanta, Georgia, by Wilfred T. Neill (1940). *Eumeces skiltonianus skiltonianus* is reported by Thomas L. Rodgers and William L. Jellison from Montana, the first record of the genus within the state boundaries. Karl P. Schmidt (1941) reports *Eumeces sumichrasti* and *Eumeces schwartzei* from British Honduras.

The presence of *Eumeces fasciatus* in Florida is questioned by Coleman J. Goin (1940). An examination of the specimens reported by Taylor (1936, p. 207) together with an inquiry as to their source leads to the conclusion that the specimens have incorrect locality data. The presence of the species in the neighboring territory of Georgia is not questioned.

A record for *Eumeces brevilineatus* from Imboden, Lawrence county, Arkansas, is given by S. C. Dellinger and J. D. Black (1938). As the record places the form so far from its known range it seems likely that some mixup in data may be responsible; at any rate its presence in Lawrence county, Arkansas, should be attested by other specimens before the range is extended to include this region of Arkansas.

NEW FORMS DESCRIBED

A few new species have been recognized and described. It would appear that all the newly named forms merit nomenclatorial designation.

Eumeces tamdaoensis Bourret, Tam-dao, French Indo China. This species is presumably related to *Eumeces elegans*. "Ce Lézard diffère de *E. elegans* par la présence d'une postnasale, et de deux postmentales impaires au lieu d'une, et par le dessin de la tête chez le jeune."

Eumeces coreensis Doi and Kamita, West Corea. This species is said to be related to *Eumeces chinensis.*

Eumeces schneideri variegatus Schmidt, Persepolis, Iran. "Allied to *Eumeces schneideri,* from which it is distinguished by its vermiculate or mottled pattern, and its more numerous nuchals. Distinguished from *Eumeces zarudnyi* in having only four auricular lobules and no lateral line."

(*Eumeces chinensis* var. nov. is listed by Pen and Ho [1932] who do not offer a name for the form.)

HABITS

Thos. G. Scott and Reuben B. Sheldahl (1937) present a short note on hibernation of *Eumeces septentrionalis:*

"The skinks were found beneath a ledge of yellow clay about four and one-half feet below the surface. The lizards, 52 in number, were assembled in a compact group about the size and shape of a football. A soft web-like material surrounded the mass and adhered to the bodies of the animals. Upon being uncovered some of them exhibited signs of life by a slight movement; others were dead." The date of this discovery was February 15.

TAXONOMY

The nomenclatorial changes and the forms proposed by Taylor (1936) have met with varying favor. At the present time most workers recognize the three American species, *Eumeces fasciatus, laticeps* and *inexpectatus,* although at first some doubt was cast on the validity of the species, presumably because an insufficient number of specimens were available to the worker concerned or too few specimens had been examined.

See: Barbour and Carr (1940), Beck (1938), Conant (1932, 1938a), Dellinger and Black (1938), Henning (1938), Jopson (1940), King (1939), McCauley (1939a, 1939b important paper on the differences in the young of *fasciatus* and *laticeps*, 1940), Netting (1936b), Parker (1939), and Turner (1935).

A notable exception is Burt (1937), who places *inexpectatus* and *laticeps* in the synonymy of *fasciatus,* even after having examined considerable material.

The separation of *Eumeces egregius* into two forms, either as subspecies or as full species, apparently is generally accepted. Although treating *egregius* and *onocrepis* as subspecies, Taylor was himself uncertain whether specific or subspecific designation showed the correct relationship (see Taylor, 1936, p. 496).

Three new specimens of *Eumeces gaigei* Taylor have been reported by Bailey (1937).

The status of the western skinks of the *skiltonianus* group has received little comment, and remains much as suggested by Taylor. A study of this group is under way at the present time, which may bring additional evidence to prove or disprove the present arrangement.

Perhaps the proposal to recognize the north African and western Asiatic forms as distinct species rather than subspecies of a single species has met with the least favor. A posthumus paper by Franz Werner points out certain errors in Taylor's work and concludes that at least *Eumeces pavimentatus* is a subspecies of *schneideri*. He criticizes Taylor for recording the color markings of preserved specimens (see Taylor, 1936, p. 25). One of the most interesting comments in his general criticism of North American workers. He states: "Es ist immer bedauerlich, wenn sich nordamerikanische Autoren mit paläarktischem Material befassen, das dann entweder nicht ausreicht oder infolge ungenügendem Verständnis für tiergeographische Möglichkeiten zu derartigen Ergebnissen führt."

CORRECTIONS

Since the publication of the monograph certain errors have been discovered by the author or by readers who have had the kindness to call the attention of the author to them.

The name of the author Doumergue, is spelled incorrectly throughout, "Domergue," save in the bibliography where the error was corrected. The name Geoffroy-Saint Hilaire is incorrectly spelled Geoffroy Saint-Hillaire. "Ebendaher" is given as a locality for *Eumeces algeriensis* whereas it is intended as "same locality." (See Boettger, Katalog, 1893, p. 112. The word is placed in the same special type as the place names, hence the error.) The date of publication of the article listed in the bibliography as Boulenger, 1895, is incorrect. The volume bears this date, but the individual papers were issued separately and earlier. This should read Boulenger, 1891. The date on the publication listed as Mertens, 1924a, should read Mertens, 1920. Page 82, in distribution of *Eumeces schneideri* read Western Asia, not "Eastern Asia." Page 298, include *Eumeces tetragrammus* var. *funebrosus* Cope, Ann. Rept. U. S. Nat. Mus., 1898 (1900), p. 661, in the synonymy of *Eumeces tetragrammus*. Page 360, under *Eumeces humilis*, read postmental double, not "single." The form described apparently is separable from *humilis*. Page 426, Tooele Co., Idaho, should be Tooele Co.,

Utah. Page 415, read parietals enclose interparietal, not "enclose parietal" (Line 20). Page 489, Mazatlán, 22 Km. south of Chilpancingo, not "4 miles south."

Concerning the derivation of the name *Eumeces*, Stejneger (Bull. U. S. Nat. Mus., No. 58) has suggested that the word means *elongated*. I find the following use of the word in Pliny:* "Eumeces is a stone of Bactriana, like silex in appearance, placed beneath the head, it produces visions in the night of an oracular description," and in a footnote is added (presumably by the translator), "'Of fair length.' Ajasson thinks that this may have been a variety of pyromahic silex, or gun flint, nearly allied to chalcedony."

The appended bibliography consists chiefly of papers that have been published since the completion of my monograph on the genus, Taylor (1936), and a few titles that were unintentionally omitted from the bibliography in that work. It is complete only to the extent that it contains all titles I have been able to find. Papers marked with an asterisk (*) have not been examined. It may be considered as a supplement to the bibliography in the monograph.

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ANDERSON, OSCAR I., and SLATER, JAMES R.

1941. Life zone distribution of the Oregon reptiles. Occ. Papers Dept. Biol., College of Puget Sound, No. 15, Oct. 15, 1941, pp. 109-119.

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ANGEL, F.

1936. Reptiles et batraciens de Syrie et de Mésopotamie récoltés par M. P. Pallary. Bull. Inst. d'Egypte T. XVIII, 1935-1936 (1936).

Eumeces schneideri Daudin listed, with several locality records.

Anonymous.

1941. Another skink. New Engl. Nat., 1941, No. 11, p. 8.

BABBITT, LEWIS H.

1939. The blue-tailed skink in Connecticut. New Engl. Nat., 1939, No. 4, pp. 14-16, illus.

Two specimens of *Eumeces fasciatus* from Kent, Conn. A figure illustrates a *Eumeces*, either *inexpectatus* or *laticeps*, from Sebastian, Florida.

BABCOCK, HAROLD L.

1934. The capture of the Bermudian lizard, *Eumeces longirostris* Cope. Copeia, 1934, No. 4, Dec. 31, p. 182.

Ingenious device for the capture of the species.

* In Pliny (The Elder) Book XXXVII, chap. 28, Vol. 6, pp. 488 (Translation), Bostock and Riley, London, 1857.

BAILEY, J. R.

1937. Three additional specimens of *Eumeces gaigei*. Herpetologica, Vol. I, 1937, p. 96.

BARBOUR, THOMAS, and CARR, A. F.

1940. *Eumeces* in the Miami area. Copeia, No. 2, July 28, 1940, p. 129.

State that *Eumeces inexpectatus* seems to be unquestionably distinct. Discusses habitat. Remarks on the absence of *Eumeces egregius*.

BECK, W. M.

1938. Notes on the reptiles of Payne's Prairie, Alachua County, Florida. The Florida Naturalist, 11, 4, July, 1938, pp. 85-87. [Separate, 4 pages unnumbered.]

Eumeces inexpectatus and *Eumeces fasciatus* listed.

BOULENGER, GEORGE ALBERT.

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*1923. Etude sur les batraciens et les reptiles rapportés par M. Henri Gadeau de Kerville de son voyage Zoologique en Syrie. (In) Voyage Zoologique d'Henri Gadeau de Kerville en Syrie, 4, Rouen, 1923, pp. 1-55, pl. 6, figs. 1-2. Tables.

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Lists *Eumeces elegans* from Yunnan; *Eumeces quadrilineatus* from an unknown locality, and *Eumeces tamdaoensis* is described as a new species, fig. 5 and pl. figs. C, D, from Tam-dao, Indochina.

Differs from *elegans* in having a postnasal and two postmentals. Young colored differently.

1939a. Reptiles et batraciens reçus au Laboratoire des Sciences Naturelles de l'Universite au cours de l'année 1938. Descriptions de trois espèces nouvelles. [Notes Herpetologiques sur l'Indochine Française No. XVII.] Bull. Gén. l'Inst. Publ. No. 6, Feb. 1939, pp. 13-34, 1 pl., text figs. 1-2.

Lists *Eumeces tamdaoensis*.

1939b. La Faune Herpétologique des stations d'Altitude du Tonkin. [Notes Herpétologique sur l'Indochine Française No. XIX.] Bull. Gén. l'Inst. Publ. No. 4, Déc. 1939, pp. 41-47.

Lists *Eumeces tamdaoensis* from *Tam-dao,* and *Eumeces quadrilineatus* from Mao Son.

1939c. Liste des Reptiles et Batraciens actuellement connus en Indochine Française. [Notes Herpétologiques sur l'Indochine Française No. XX.] Bull. Gén. l'Inst. Publ. No. 4, Déc. 1939, pp. 49-60.

Lists *Eumeces quadrilineatus* and *E. tamdaoensis*.

BOYER, DOROTHY A., and HEINZE, ALBERT A.

1934. An annotated list of the amphibians and reptiles of Jefferson County, Mo. Trans. Acad. Sci. St. Louis, Vol. 28, No. 4, 1934, pp. 183-200, figs. 1-2.

Eumeces anthracinus and *fasciatus* listed, with brief notes on habits.

BRADY, M. K.

1937. Natural history of Plummers Island, Maryland. VI. Reptiles and amphibians. Proc. Biol. Soc. Washington, Vol. 50, 1937, pp. 137-140.

Eumeces fasciatus listed.

BRENNAN, L. A.

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BREUKELMAN, JOHN, and DOWNS, ALLEN.

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Lists for North Carolina four species of *Eumeces: fasciatus, laticeps, inexpectatus* and *anthracinus.*

BURT, CHARLES E.

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Eumeces obsoletus listed.

1937b. The Lizards of the Southeastern United States. Trans. Kansas Acad. Sci., Vol. 40, 1937, pp. 349-366.

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BURT, CHARLES E., and MYERS, GEORGE S.

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CAGLE, FRED R.

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GENTRY, GLENN

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GOIN, COLEMAN J.

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GORDON, KENNETH

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Eumeces skiltonianus is recorded.

GRANT, CHAPMAN

1936a. Herpetological notes from northern Indiana. Proc. Indiana Acad. Sci., Vol. 45, 1936, pp. 323-333.

Eumeces fasciatus listed from Jasper-Pulaski Counties State Game Preserve, and at Valparaiso, Ind.

1936b. Herpetological notes from Fort Knox, Kentucky. Proc. Indiana Acad. Sci., Vol. 45, 1936, p. 334.

Eumeces fasciatus reported.

GREEN, N. BAYARD

1937. The amphibians and reptiles of Randolph County, West Virginia. Herpetologica, Vol. 1, No. 4, Nov. 16, 1937, pp. 113-116.

Eumeces fasciatus recorded.

1940. The symposium of West Virginia Herpetology. The herpetological collection of the West Virginia Biological Survey. Proc. West Virginia Acad. Sci., Vol. 14, 1940, 1 p. (In W. Va. Univ. Bul., Ser., 41, No. 4, II, Oct., 1940).

Eumeces anthracinus and *E. laticeps* mentioned.

1941. Amphibians and reptiles of the Huntington region. Marshall Review, Vol. 4, No. 2, 1941, pp. 33-40.

Eumeces fasciatus and *laticeps* recorded, and *anthracinus* considered hypothetical.

HAHN, WALTER L.

1908. Notes on the mammals and cold-blooded vertebrates of the Indiana University Farm, Mitchell, Indiana. Proc. U. S. Nat. Mus., Vol. 35, 1908, pp. 545-581.

Eumeces fasciatus from New Harmony and Mitchell.

HARWOOD, PAUL D.

1932. The helminths parasitic in the amphibia and reptilia of Houston, Texas, and vicinity. Proc. U. S. Nat. Mus., Vol. 81, No. 17, 1932, pp. 1-71, pls. 1-5.

Eumeces fasciatus, Houston, Texas, various helminth species parasitic; *Eumeces septentrionalis* mentioned, no parasites.

HARDY, ROSS.

1939. Some notes on Utah reptiles. Proc. Utah Acad. Sci., Arts Lett., Vol. 16, 1939, p. 83.

Eumeces skiltonianus skiltonianus Clear Creek (five miles east of Zion Park boundary), Kane county; Pine Valley and Oak Grove, Washington county.

HENNING, WILLARD L.

1938. Amphibians and Reptiles of a 2,200 acre tract in Central Missouri. Copeia, 1938, No. 2, June 30, pp. 91-92.

Eumeces fasciatus and *Eumeces laticeps* listed.

HIBBARD, C. W.

1937. The amphibians and reptiles of Mammoth Cave National Park proposed. Trans. Kansas Acad. Sci., Vol. 39, 1936 (1937), pp. 277-281.

Eumeces anthracinus, fasciatus and *laticeps*. First state record of *anthracinus* in Kentucky.

HOYLE, WILLIAM LUTHER.

1937. Notes on faunal collecting in Kansas. Trans. Kansas Acad. Sci., Vol. 39, 1936 (1937), pp. 283-293.

Eumeces obsoletus recorded from Cowley county and Carneiro, Ellsworth county; *E. fasciatus* from Mortimer, Labette county.

HUDSON, GEORGE E.

1942. The amphibians and reptiles of Nebraska. Nebr. Cons. Bull., No. 24, 1942, pp. i-iv, 1-146, pls. 1-20, maps 1-32.

Eumeces fasciatus, multivirgatus, obsoletus and *septentrionalis septentrionalis* recorded from Nebraska.

JOPSON, HARRY G. M.

1938. Observation of the survival value of the character of the blue tail in *Eumeces*. Copeia, 1938, No. 2, June 30, p. 90.

1940. Reptiles and amphibians from Georgetown County, South Carolina. Herpetologica, Vol. 2, No. 2, Dec. 30, 1940, pp. 39-43.

Eumeces laticeps common.

JOHNSON, MURRAY L.

1942. A distributional check-list of the reptiles of Washington, Copeia, 1942, No. 1, Mar. 24, pp. 15-18.

Eumeces skiltonian [sic] *skiltonianus* reported to be fairly common in the Cascade Range.

KAUFFELD, CARL F.

1941. The red-tailed skink, *Eumeces egregius*, in Alabama. Copeia, 1941, No. 1, Mar. 25, p. 51.

KING, WILLIS.

1939. A survey of the herpetology of Great Smoky Mountains National Park. Amer. Mid. Nat., Vol. 21, No. 3, May 1939, pp. 531-582, figs. 1-9.

Eumeces fasciatus, E. laticeps and *E. inexpectatus* occur.

KLAUBER, L. M.

1939. Studies of reptile life in the arid southwest. Bull. Zoöl. Soc. San Diego, No. 14, 1939, pp. 1-100, tables 1-15.

Black peritoneum reported in *E. obsoletus* (p. 76); *E. skiltonianus skiltonianus* compared with *gilberti rubricaudatus*.

KNOWLTON, G. F., and JANES, M. F.

1933. Lizards as predators of the beet leafhopper. Journ. Econ. Ent., Vol. 26, 1933, pp. 1011-1016.

Eumeces skiltonianus from 3.5 miles west of Clover, Tooele county, Utah, with a beet leafhopper in stomach.

LAMPE, ED.

1901. Catalog der Reptilien-Sammlung (Schildkröten, Crocodile, Eidechsen und Chamaeleons) des Naturhistorischen Museums zu Wiesbaden. Jahrb. Nassau. Ver. Natur., Jahr. 54, 1901, pp. 1-46, pl. III.

Eumeces algeriensis listed from Mogador.

LAMSON, GEORGE HERBERT

1935. The Reptiles of Connecticut. State of Connecticut, State Geological and Nat. Hist. Survey Bull., No. 54, 1935, pp. 1-35, pls. I-XII.

Eumeces fasciatus reported.

LICHTENSTEIN, H.

*1856. Nomenclator reptilium et amphibiorum musei zoologici berolinensis. iv, 48 pp.

Certain species mentioned. *Plestiodon quinquelineatum* recorded from México.

LINSDALE, JEAN M.

1938. Environmental responses of vertebrates in the Great Basin. Amer. Mid. Nat., Vol. 19, No. 1, Jan. 1938, pp. 1-206, figs. 1-12.

Eumeces skiltonianus is recorded.

1940. Amphibians and reptiles in Nevada. Proc. Amer. Acad. Arts Sci., Vol. 73, No. 8, May, 1940, pp. 197-257, figs. 1-29.

Eumeces skiltonianus skiltonianus reported from five counties in Nevada.

LITTLE, ELBERT L., JR.

1940. Amphibians and reptiles of the Roosevelt Reservoir area, Arizona. Copeia, 1940, No. 4, Dec. 27, pp. 260-265.

Eumeces obsoletus listed.

LITTLE, ELBERT L., JR., and KELLER, JOHN G.

1937. Amphibians and reptiles of the Jornada Experimental Range, New Mexico. Copeia, 1937, No. 4, Dec. 31, pp. 216-222.

Eumeces obsoletus reported. Food of the species is listed.

LOGIER, E. B. S.

1939. The reptiles of Ontario. Royal Ontario Mus. Handbook No. 4, 1939, pp. 1-63 + II, pls. 1-8.

Eumeces fasciatus discussed. Plate I figures squamation.

1941. The amphibians and reptiles of Prince Edward county, Ontario. Univ. Toronto Studies, Biol. Ser. No. 48, 1941, pp. 93-106.

Eumeces fasciatus, likely to be found because of its distribution.

LOGIER, E. B. S., and TONER, G. C.

1942. Amphibians and reptiles of Canada. The Canadian Field-Nat., Vol. 56, No. 2, Feb., 1942, pp. 15-16.

Lists *Eumeces fasciatus*, *E. septentrionalis septentrionalis*, and *E. skiltonianus skiltonianus* from Canada.

LOVERIDGE, A.

1930. On some skinks of the genus *Eumeces* from North America. Copeia, 1930, No. 173, Jan. 16, pp. 111-112.

LYNN, W. GARDNER

1936. Reptile records from Stafford county, Virginia. Copeia, 1936, No. 3, Nov. 15, pp. 169-171.

Records *Eumeces fasciatus*.

MANSUETI, ROMEO

1941. A descriptive catalogue of the amphibians and reptiles found in and around Baltimore City, Maryland, within a radius of twenty miles. Proc. Nat. Hist. Soc. Maryland No. 7, Dec., 1941, pp. iii + 1-53.

MARTIN DEL CAMPO, RAFAEL

1940. Nota acerca de algunos vertebrados de las lagunas de Cempoala y sus alrededores. Anal. Inst. Biol. Mexico, Vol. 11, pt. 2, 1940, pp. 741-743.

Eumeces copei, ovoviviparity.

McCAULEY, ROBERT H., JR.

1939a. Notes on the food habits of certain Maryland lizards. Amer. Mid. Nat., Vol. 22, No. 1, July, 1939, pp. 150-153.

Account of the food habits of *Eumeces fasciatus* and *E. laticeps*.

1939b. Differences in the young of *Eumeces fasciatus* and *Eumeces laticeps*. Copeia, 1939, No. 2, July 12, pp. 93-95.

An excellent account of differences in eggs and young of the two species.

1940a. A distributional study of the reptiles of Maryland and the District of Columbia. Cornell Univ. Abstracts of Theses, 1940, pp. 267-269.

Reports *Eumeces anthracinus*, *E. fasciatus*, and *E. laticeps*.

1940b. A record for *Eumeces anthracinus* from Georgia. Copeia, 1940, No. 1, Mar. 30, p. 50. Corrects a record given by Taylor, (Mountain City Gap, Maryland) to Wilson Gap, near Mountain City, Rabun county Georgia. *Fide* the collector of the specimen J. C. Bradley.

McCLELLAN, WILLIAM M.

*Some question on Eumeces in Maryland. Nat. Hist. Soc. Maryland, 10th Ann. Senior Bull., Vol. 9, No. 7, pp. 59-62.

McILHENNY, E. A.

1937. Notes on the five lined skink. Copeia, 1937, No. 4, Dec. 31, pp. 232-233.

A very vigorous account of a very large *Eumeces fasciatus* attacking wasp nests. It is probable that the *"Eumeces fasciatus"* is in reality *E. laticeps*.

MERTENS, ROBERT.

*1931. Zoologischer Jahrb. Jena Bd. LXI, 1931, p. 66.

Eumeces schneideri.

MOORE, GEORGE A., and RIGNEY, CARL C.

1942. Notes on the herpetology of Payne county, Oklahoma. Proc. Okla. Acad. Sci., 1941, pp. 77-80.

Eumeces fasciatus, *obsoletus* and *septentrionalis* recorded.

MOSAUER, WALTER.

1934. The reptiles and amphibians of Tunisia. Publ. Univ. California at Los Angeles in Biol. Sci., Vol. 1, No. 3, 1934, pp. 49-64, 1 text fig., 1 map.

Eumeces schneideri reported from Gafsa, Tunisia.

MULAIK, STANLEY.

1935. Tail regeneration in *Coleonyx brevis* Stejneger. Copeia, 1935, No. 3, Oct. 15, pp. 155-156.

Casual mention of food storage in the tail, in *Eumeces*.

MURRAY, LEO. T.

1939. Annotated list of amphibians and reptiles from Chisos Mountains. Contributions from Baylor Univ. Mus. No. 24, July 15, 1939, pp. 4-16.

Reports *Eumeces obsoletus* from elevation of 5000 feet or higher.

NECKER, WALTER L.

1938. Check list of reptiles and amphibians of the Chicago region. The Chicago Acad. Sci., Leaflet No. 1, Sept. 25, 1938, pp. [1-4].

Eumeces fasciatus listed.

1939. Records of amphibians and reptiles of the Chicago region, 1935-1938. Bull. Chicago Acad. Sci. Vol. 6, No. 1, July 21, 1939, pp. 1-10.

Eumeces fasciatus.

1939a. Revised check list of reptiles and amphibians of the Chicago region. Chicago Acad. Sci. Leaflet II, 1939, pp. 1-4.

Eumeces fasciatus from Cook and Lake Counties.

NEILL, WILFRED T.

1940. *Eumeces egregius* in Georgia. Copeia, 1940, No. 4, Dec. 27, p. 266. Lake Ormond, 4 mi. east of Augusta is the northern-most record.

NETTING, M. GRAHAM.

1935. A nontechnical key to the amphibians and reptiles of Western Pennsylvania. Nawakwa Fireside Series, Nos. 3 and 4 combined 1934-'35, Apr., 1935, pp. 33-49.

Reports *Eumeces anthracinus* from Clearfield and Clinton Counties; *Eumeces fasciatus* from Alleghany, Clarion, Center, Clinton, Huntington and Westmoreland Counties.

1936a. The amphibians and reptiles of Indiana county, Pennsylvania. Proc. Pennsylvania Acad. Sci., Vol. X, 1936, pp. 25-28.

Eumeces anthracinus and *E. fasciatus* listed as "species which probably occur."

1936b. Hand list of the amphibians and reptiles of Pennsylvania. Herpetology leaflet No. 1, Carnegie Mus., July 18, 1936, pp. [1-4].

Lists *Eumeces fasciatus, E. laticeps* and *E. anthracinus* for the state.

1939a. Reptiles killed on a "vermin" campaign in Mercer county, West Virginia. Proc. West Virginia Acad. Sci., 1939, Vol. 13, pp. 162-166.

Eumeces fasciatus.

1939b. The reptiles of Pennsylvania. Bien. Rept. Pa. Fish Comm., 1936-1938 (1939), pp. 122-132.

Eumeces anthracinus, fasciatus and *laticeps* recorded.

1940. *Anolis carolinensis* eaten by *Eumeces laticeps.* Copeia, 1940, No. 4, Dec. 27, p. 266.

NOBLE, G. K., and KUMPF, K. F.

1936. The function of Jacobson's organ in lizards. Journ. Genetic Psychology, 48, 2, 1936, pp. 371-382.

Eumeces laticeps tested.

OLIVER, JAMES H.

1937. Notes on a collection of amphibians and reptiles from the State of Colima, Mexico. Occ. Papers Mus. Zoöl. Univ. Michigan, No. 360, Nov. 20, 1937, pp. 1-28, pl. 1, text fig. 1.

Eumeces parvulus reported from Colima, México.

OWEN, ROBERT P.

1940. A list of the Reptiles of Washington. Copeia, 1940, No. 3, Nov. 14, pp. 169-172.

Eumeces skiltonianus skiltonianus listed from several localities.

PARKER, MALCOLM V.

1937. Some amphibians and reptiles from Reelfoot Lake. Journ. Tennessee Acad. Sci., Vol. XII, No. 1, Jan., 1937, pp. 60-86, figs. 1-18.

Eumeces fasciatus listed and figured, fig. 3-B.

1939. The amphibians and reptiles from Reelfoot Lake and vicinity, with a key for the separation of the species and subspecies. Rept. Reelfoot Lake Biol. Sta., Vol. III, Jan., 1939, pp. 72-101.

Eumeces fasciatus and *E. laticeps* reported.

PAWLING, R. OLDT.

1939. The amphibians and reptiles of Union county, Pennsylvania. Herpetologica, Vol. 1, No. 6, July 22, 1939, pp. 165-169.

PEN, K. H., and HO, W. C.

1932. A preliminary survey of the lizards of southwestern Szechuan. J. W. China. Border Res. Soc., 5, 1932, pp. 104-129, figs.

Eumeces chinensis var. nov. is listed but the form is not named.

PETERS, JAMES A.

1942. Reptiles and amphibians of Cumberland county, Illinois. Copeia, 1942, No. 3, pp. 182-183.

Eumeces laticeps and *fasciatus*.

QUAINTANCE, CHAS. W.

1935. Reptiles and amphibians from Eagle Creek, Greenlee county, Arizona. Copeia, 1935, No. 4, Dec. 31, pp. 183-185.

Eumeces obsoletus reported from 8,787 ft. elevation on top of Rose Peak.

RICHMOND, NEIL D., and GOIN, COLEMAN J.

1938. Notes on a collection of amphibians and reptiles from New Kent county, Virginia. Annals of the Carnegie Mus., Vol. 27, Dec. 23, 1938, pp. 301-310.

RODGERS, THOMAS L., and JELLISON, WILLIAM L.

1942. A collection of amphibians and reptiles from Western Montana. Copeia, 1942, No. 1, Mar. 24, pp. 10-13.

Records *Eumeces skiltonianus skiltonianus* from Ravalli county, Montana, the first state record.

ROUDABUSH, ROBERT L.

1937. Some coccidia of reptiles found in North America. Journ. Parasitology, 23, 4, 1937, pp. 354-359, figs. 1-5.

Eumeces septentrionalis, negative results in examinations.

ROUDABUSH, ROBERT, and COATNEY, G. ROBERT

1937. On some blood protozoa of reptiles and amphibians. Trans. Amer. Micr. Soc., Vol. 56, No. 3, 1937, pp. 291-297, pls. 1-2.

Eumeces septentrionalis, negative results.

SCHMIDT, KARL P.

1936a. A key to the Lizards of the United States and Canada, by Charles E. Burt (Review). Copeia, 1936, No. 2, July 31, p. 127.

Eumeces fasciatus mentioned nominally.

1936b. A taxonomic study of the cosmopolitan Scincoid lizards of the genus Eumeces with an account of the distributional relationships of its species [*sic*] by Edward H. Taylor (Review). Copeia, 1936, No. 4, Dec. 31, pp. 242-243.

Eumeces septentrionalis in Wisconsin; comments on the status of *E. laticeps* and *E. fasciatus*.

1939. Reptiles and Amphibians from southwestern Asia. Zoöl. Series Field Mus. Nat. Hist., Vol. 24, No. 27, Sept. 19, 1939, pp. 49-92, 1 map.

Eumeces schneideri princeps reported from Hatay and Iraq. A new subspecies *Eumeces schneideri variegatus* is described from Persepolis, Iran.

1941. The amphibians and reptiles of British Honduras. Field Mus. Nat. Hist., Zoöl. Series, Vol. XXII, No. 8, (publ. 512) Dec. 30, 1941, pp. 475-510, fig. 38.

Eumeces sumichrasti reported from Cohuni Ridge and Retiro. *E. schwartzei,* Cockscomb Mts., eastern slope in British Honduras.

SCHMIDT, KARL P., and NECKER, WALTER L.

1935. Amphibians and reptiles of the Chicago region. Bull. Chicago Acad. Sci., Vol. 5, No. 4, Sept. 27, 1935, pp. 57-77.

Eumeces fasciatus reported from Cook county, Ill., and Lake county, Indiana.

SCHWARDT, H. H.

1938. Reptiles of Arkansas. Univ. Ark. Coll. Agri. Exp. Sta. Bull., No. 357, 1938, pp. 1-47, figs. 1-53.

Eumeces anthracinus and *Emeces fasciatus,* county records. On the authority of several authors, includes *laticeps* with *fasciatus.*

SCOTT, THOS. G., and SHELDAHL, REUBEN B.

1937. Black-Banded skink in Iowa. Copeia, 1937, No. 3, Nov. 19, p. 192.

Report of finding hibernating specimens of *Eumeces septentrionalis,* 52 in number, assembled in a compact group the size and shape of a football, Feb. 15, 1937. They were 4½ feet below the surface.

SHOUP, C. S., PEYTON, J. H.; and GENTRY, GLENN.

1941. A limited biological survey of the Obey River and adjacent streams in Tennessee. Journ. Tennessee Acad. Sci., Vol. 16, 1941, pp. 48-76.

Eumeces fasciatus from Carter Creek, Clinton county, Kentucky.

SLATER, JAMES R.

1941. The distribution of amphibians and reptiles in Idaho. Occ. papers Dept. of Biol., College of Puget Sound, No. 14, Oct. 15, 1941, pp. 78-109.

Eumeces skiltonianus skiltonianus "occurs throughout the state."

SLEVIN, JOSEPH R.

1937. Contributions to Oriental herpetology V. Honshu or Hondo, the neighboring islands of Sado, and Awaji, and the seven islands of Idzu. Proc. California Acad. Sci., 4th Ser., Vol. XXIII, No. 11, Dec. 30, 1937, pp. 175-190.

Eumeces latiscultatus okadae reported from Idzu.

SMITH, HOBART MUIR.

1938. Notes on the reptiles and amphibians from Yucatán and Campeche, Mexico. Occ. Papers Mus. Zoöl., Univ. Michigan, No. 388, Oct. 31, 1938, pp. 1-22, pl. 1.

Reports *Eumeces schwartzei* from Tres Brazos and Encarnación, Campeche, México.

SMITH, MALCOLM ARTHUR.

1935. The fauna of British India including Ceylon and Burma Reptilia and Amphibia, Vol. II, Sauria. 8vo. London, Feb. 2, 1935, vii + 440, 1 pl., text figs. 1-94, 2 maps.

Treats of *Eumeces chinensis, E. quadrilineatus, E. blythianus, E. schneideri* and *E. taeniolatus.*

SPRINGER, STEWART.

1928. A list of reptiles and amphibians taken in Marion county, Indiana, in 1924-1927. Proc. Indiana Acad. Sci., Vol. 37, 1928, pp. 491-492.

Eumeces fasciatus listed.

STAFFORD, W. E.

1917. Natural history of Paradise Key and the nearby Everglades of Florida. Ann. Rept. Smith Inst., 1917, pp. 377-434, 64 pls., 32 figs., 1 map.

Discusses *Plestiodon egregius.*

STEJNEGER, LEONHARD.

1936. Types of the amphibian and reptilian Genera proposed by Laurenti in 1768. Copeia, 1836, No. 3, Nov. 15, pp. 133-141.

Eumeces punctatus mentioned; is not of the genus *Eumeces* as now understood.

STRECKER, JOHN KERN

1935a. The reptiles of West Frio Canyon, Real county, Texas. The Baylor Bull., Vol. XXXVIII, No. 3, Aug., 1935, p. 32.

Eumeces brevilineatus and *E. obsoletus* recorded.

1935b. A list of hitherto unpublished localities for Texas amphibians and reptiles. The Baylor Bull., Vol. XXXVIII, No. 3, Aug., 1935, pp. 35-38.

Records *Eumeces brevilineatus* from several localities in McLennan county, Texas.

STRECKER, JOHN KERN, and JOHNSON, J. E., JR.

1935. Notes on the herpetology of Wilson county, Texas. The Baylor Bull., Vol. XXXVIII, No. 3, Aug., 1935, pp. 17-23. Lists.

Eumeces brevilineatus, Cibola river bottoms; and *Eumeces obsoletus,* both in Wilson county, Texas.

SWANSON, PAUL.

1939. Herpetological notes from Indiana. Amer. Mid. Nat. Vol. 22, No. 3, Nov., 1939, pp. 684-696.

Reports *Eumeces fasciatus* from Pike, Posey and Brown counties. Mentions a "huge eleven-inch specimen" from Brown county; *Eumeces laticeps* from Martin county.

TANNER, WILMER W.

1940. Notes on the herpetological specimens added to the Brigham Young University vertebrate collection during 1939. Great Basin Naturalist, Vol. 1, 1940, pp. 138-146.

Eumeces fasiatus from Reelfoot Lake, Obion county, Tennessee; *Eumeces s. skiltonianus* from West Canyon and Diamond Fork Canyon, Utah county, Utah, and Junction of Steamboat and North Umpqua rivers, Douglas county, Oregon.

TAYLOR, EDWARD H.

1935. A new species of the Genus *Eumeces* from New Mexico. Uni. Kansas Sci. Bull., Vol. XXII, No. 11, 1935 (Nov. 15, 1935), pp. 219-223, text fig. 1.

Eumeces gaigei described.

1936. Proposed changes in the nomenclature of the scincoid lizard, genus *Eumeces.* Trans. Kansas Acad. Sci., Vol. 38, 1935 (April 25, 1936), pp. 345-347.

1936. A taxonomic study of the cosmopolitan scincoid lizards of the genus *Eumeces* with an account of the distribution and relationships of its species. Univ. Kansas Sci. Bull., Vol. XXIII, No. 1, 1935 (Aug. 15, 1936), pp. 1-643, pls. I-XLIII; figs. 1-84.

Monographic treatment of all known forms. *Eumeces gilberti rubricaudatus* described as new from California.

TCHANG, T. L.

1936. Notes on some reptiles from South China and Kirin. Bull. Fan. Mem. Inst. Biol. (Zoöl.), Vol. VI, No. 5, 1936, pp. 223-231.

Eumeces elegans from Kuatun, Fukien.

TIHEN, JOE A.

1937. Additional distributional records of amphibians and reptiles in Kansas counties. Trans. Kansas Acad. Sci., Vol. 40, 1937, pp. 401-409.

Reports *Eumeces fasciatus* from Ness and Osage counties. "Two specimens of this lizard were found in Ness county on January 13, 1934, eight feet under ground."

Eumeces septentrionalis septentrionalis reported in Comanche, Linn and Osage counties. The Comanche county specimens seem to be intergrades between *septentrionalis* and *obtusirostris*, the color resembling the latter, the squamation the former.

TROWBRIDGE, ALBERT H.

1937. Ecological observations on amphibians and reptiles collected in southeastern Oklahoma during the summer of 1934. Amer. Midl. Nat., Vol. 18, No. 2, 1937, pp. 285-303.

Eumeces anthracinus from 14 mi. southeast of Broken Bow, McCurtain county; *Eumeces fasciatus* from McCurtain and LeFlore counties; *Eumeces obsoletus* from McCurtain and LeFlore counties.

TURNER, CLARENCE D.

1935. The effects of antuitrin-s on the male genital organs of the lizard (*Eumeces laticeps*) during seasonal atrophy. Biol. Bull., Vol LXIX, No. 1, Aug., 1935, pp. 143-158, figs. 1-13.

VIOSCA, PERCY.

1926. Distributional problems of the cold-blooded vertebrates of the Gulf Coastal Plain. Ecology, Vol. VII, No. 3, July 1926, pp. 307-314.

Eumeces fasciatus classified as an Eastern Austral species.

1931. Amphibians and reptiles of Louisiana. Southern Biol. Supply Co., Price list No. 20, pp. 1-12.

Plestiodon fasciatus, "statewide"; *Plestiodon anthracinus*, "rare, in uplands."

VON BLOEKER, JACK C., JR.

1942. Amphibians and reptiles of the dunes. Bull. Southern California Acad. Sci., Vol. 41, 1942, pp. 29-38.

Eumeces skiltonianus from El Segundo San Dunes, Los Angeles county, California.

WELTER, WILFRED, and CARR, KATHERINE.

1939. Amphibians and reptiles of Northeastern Kentucky. Copeia, 1939, No. 3, Sept. 9, pp. 128-130.

Eumeces fasciatus listed.

WERNER, FRANZ.

1920. Reptilien und Amphibien aus dem Amanus-gebirge. Arch. Naturg. Berlin, Bd. 85 A, (8), 1920, pp. 130-141, 1 fig.

*1935. Im Auto durch Syrien. Blatt. Aquar-Terr. Kunde, Bd. 46, 1935, pp.

1939. Die Amphibien und Reptilien von Syrien. Abh. Ber. Mus. Natur. Verges. Natur. Verein Madgeburg, Bd. VII, heft 1, 1939, pp. 211-223, pl. 15.

Eumeces schneideri pavimentatus is listed.

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A Review of American Sibynophine Snakes, with a Proposal of a New Genus*

EDWARD H. TAYLOR and HOBART M. SMITH †

THE discovery of four new forms of Sibynophine snakes in México has led us to reëxamine as far as possible all other Mexican and Central American species known in this group, as well as certain Asiatic species of *Sibynophis* that were readily available. We have concluded that differences obtaining between American and Asiatic forms are such that the American forms should be considered as a group of generic rank separate from *Sibynophis*.

Duméril and Bibron (Erp. Gén., vol. 7, 1854, p. 328) placed the first known species of these Central American snakes in a subgenus of *Ablabes* which they called *Enicognathus,* a group largely based on a peculiar character of the lower jaw. In the group they associated four species: *Coluber melanocephalus* Linné (= *Sibynophis subpunctatus,* India, and *Tantilla melanocephala,* Guadeloupe, W. I.); *Herpetodryas rhodogaster* Schlegel (= *Sibynophis rhodogaster,* Madagascar); *Coluber geminatus* Oppel (= *Sibynophis geminatus,* Java); and their own *Enicognathus annulatus* from Guatemala. The type is *Herpetodryas geminatus* Schlegel. This generic name, preoccupied by *Enicognathus* Gray (1840) was emended by Cope in 1876 as *Henicognathus;* this in turn is preoccupied by *Henicognathus* Agassiz, 1846. Boulenger, in 1896, offered *Polyodontophis* as a substitute name for *Enicognathus.* In 1910 Stejneger pointed out that Fitzinger in 1843 had created the genus *Sibynophis* naming *Herpetodryas geminatus* Schlegel as the type. No proposed generic designation is available apparently for American species.

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† The junior author acknowledges assistance of the Walter Rathbone Bacon Traveling Scholarship.

Scaphiodontophis gen. nov.

Sibynophis Fitzinger, Syst. Rept., 1843, p. 26 (*part.*); Stejneger, Proc. U. S. Nat. Mus., vol. 38, 1910, p. 102 (*part.*); Dunn, Occ. Papers Boston Soc. Nat. Hist., vol. 5, 1930, p. 330 (key); *idem*, Copeia, 1931, p. 163; *idem*, Bull. Antiv. Inst. Amer., vol. 2, 1928, pp. 20, 24 (subfamily proposed).

Enicognathus Duméril and Bibron, Erp. Gén., vol. 7, 1854, p. 328 (*part.*).

Henicognathus Cope, Journ. Acad. Nat. Sci. Phila., vol. 8, 1876, p. 138 (*part.*).

Polyodontophis Boulenger, Fauna India, Rept., 1890, p. 301 (*part.*).

Rather small snakes (2-3 feet) with normal head squamation, the head very slightly distinct from neck; tail very long. Scales in 17 rows, smooth, lacking apical pits; subcaudals single; anal divided; a loreal, one preocular, usually two postoculars; one or two anterior temporals; hypapophyses present throughout vertebral column.

Dentary loosely attached near anterior end to articulare, leaving posterior two-thirds of the element free. Maxillary teeth numerous (more than 50), the teeth scaphoid or spatulate, smaller at anterior and posterior ends of maxilla, arranged in groups of three teeth (sometimes two) the three teeth usually differing in size and length, the third (anterior) of each triad being heaviest and longest, the first smallest. The bases of the teeth are in line, but the tips are not (a line connecting the tips of a triad is diagonal to the longitudinal axis of the jaw); a dorsal as well as a medial ectopterygoid process on maxilla; tips of teeth brownish.

Hemipenis* relatively short (ten or eleven caudals, not everted); sulcus single; distal fourth calyces; median third relatively large spines, smaller ones curved at tip, others straight; basal portion of

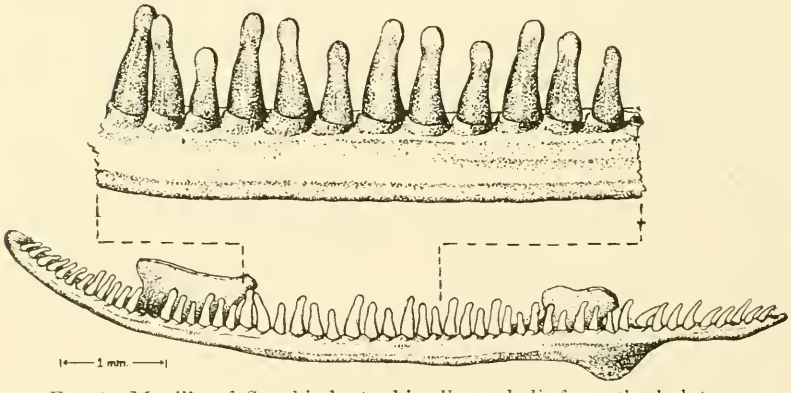


FIG. 1. Maxilla of *Scaphiodontophis albonuchalis* from the holotype, U. S. N. M. No. 110413.

* Unfortunately the hemipenes of *venustissimus* and *sumichrasti* are unknown. Since these represent types widely different from the others, their hemipenial characters may very possibly be widely different from those described here for the genotype and its closest relatives.

spinous area with two to four larger spines; basal portion (three-fifths) of hemipenis smooth, spineless, with longitudinal ridges.

We designate *Enicognathus annulatus* Duméril and Bibron as type of the genus, and refer to it *venustissimus, annulatus, hondurensis, nothus, albocinctus, zeteki, cyclurus* and *carpicinctus.* Another species, *sumichrasti,* is placed here with considerable doubt. (See discussion of this form. It may not belong in this genus.)

This group of species, which has been associated with *Sibynophis,* differs from members of that genus in having a larger series of unequal maxillary teeth (52 to 56; known maximum in *Sibynophis,* 46), arranged in diads or triads of unequal sizes; a much larger dorsal, as well as a medial ectopterygoid process (the process is very low or lacking in *Sibynophis*).

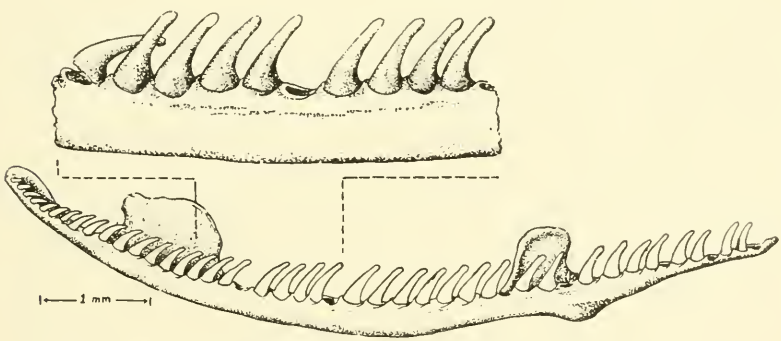


FIG. 2. Maxilla of *Sibynophis collaris,* from U. S. N. M. No. 101035, Doi Hua Mot, Northern Siam.

Most of the species of *Sibynophis* have normally pointed teeth; *subpunctatus* from Ceylon, however, has somewhat spatulate teeth; forms associated with *Scaphiodontophis* all have spatulate teeth, so far as known. All *Sibynophis* have a uniform or striped coloration; all *Scaphiodontophis* have black, yellow and red transverse spots or bars on some part or all of the body while the remainder tends to be uniform grayish with darker dots (save *sumichrasti,* which is uniformly colored with black dots forming lines and lacks the black, yellow and red bars).

That the two genera *Scaphiodontophis* and *Sibynophis* are related is evidenced by the remarkable condition of the dentary, which is very similar in the two genera, and similar to the condition obtaining in the XENOPELTIDAE. The two genera agree also in number of teeth in the palatine and pterygoid series (about fifty combined).

Species of both genera appear to suffer from a disease* that causes a total or partial loss of the tail. When the tail is complete it approaches the length of the body in some species; rarely the subcaudals reach the number of ventrals.

The food of most of the species is unknown. One specimen, the type of *albonuchalis,* had a specimen of *Leiolopisma assatum taylori* in the stomach.

We believe that the two genera *Scaphiodontophis* and *Sibynophis* together form a group worthy of subfamily rank, as Dunn proposed in 1928 (Bull. Antiv. Inst., vol. 2, 1928, p. 20). The characters defining the subfamily are "Dentary free posteriorly; hypapophyses long, narrow, and projecting posteriorly; hemipenes calyculate distally." Dunn further states that "*Sibynophis,* with species in Central America and southern Asia, differs remarkably from all other snakes. The hemipenis is of the Colubrine type. It may be considered provisionally as the monotype of a subfamily. I have compared males of *S. annulatus* from Mexico and *S. collaris* from China, and find them congeneric."

The nine members of the genus fall readily into three groups, one containing *sumichrasti,* one *venustissimus,* the other all remaining forms. The *sumichrasti* group is characterized by a striped pattern (uniform posteriorly) and a high ventral count. Both of the other groups have a banded pattern greatly different from that of *sumichrasti.* The *venustissimus* group is characterized by presence of single, yellow-bordered black bands on a red ground color—essentially a *Micrurus*-type pattern. This is greatly different from the pattern of the second group (*annulatus*), which is *Lampropeltis*-like, with double black bands enclosing a yellow band, all on a red ground color.

Two readily discernible divisions (*annulatus* and *zeteki*) in the *annulatus* group may be pointed out: (1) *annulatus* and *carpicinctus,* in which the black head cap is followed first by a portion of a red band, and then by a triad consisting of two black bands enclosing a yellow; (2) *cyclurus, zeteki, nothus* and *albocinctus,* in which the black head cap is followed by the posterior two thirds of a triad (*viz.*, a yellow followed by a black band), then the normal

* A similar disease affects *Thamnophis marcianus:* Fourteen specimens collected in a pond in New Mexico all had it. Certain specimens showed a recent loss of the tail, the stub not healed, and in others the tail was so rotten that it appeared to be held by the skin only.

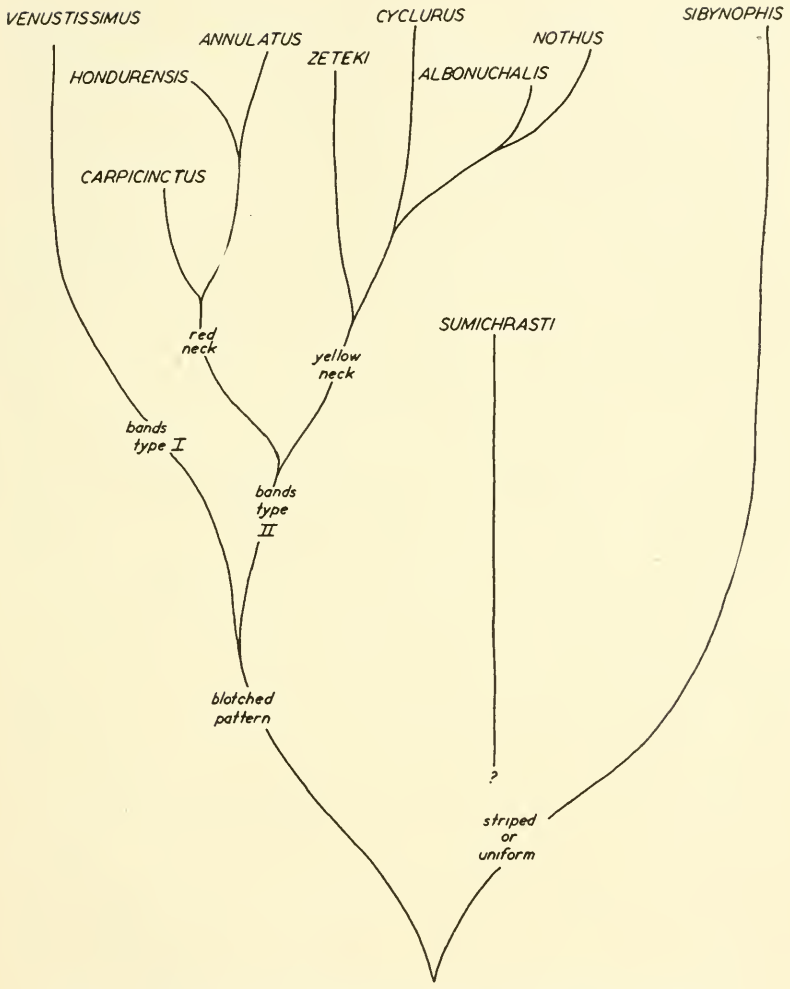


FIG. 3. Diagrammatic representation of the possible phylogeny of *Scaphiodontophis*.

succession of red bands separated by triads of black and yellow bands.

All forms of the genus here recognized are readily distinguishable one from the other (with the possible exception of *annulatus hondurensis,* which cannot be compared satisfactorily at present with typical *annulatus,* due to paucity of specimens of the latter). Certain forms, however, here described as species, may eventually be regarded as subspecies, although present data are far too inadequate

to hazard placing them as subspecies now (except in the case of *hondurensis*).

Because of the very doubtful generic allocation of *sumichrasti*, consideration of it in any scheme of phylogeny courts many gross errors in conclusions, and we therefore do not here present the various positions that species conceivably may fill in various theories of possible phylogeny of *Scaphiodontophis*.

Speculation on the pattern evolution of the other members of the genus, however, leads to interesting theories. The existence of two radically different pattern types (*i. e.*, [1] *venustissimus*, single black bands bordered by yellow; and [2] all others, double black bands enclosing a yellow) indicates a very great age, even for these species. The obvious explanation is that these were derived from a common type, not now existing, with a simple banded or blotched pattern. The banded pattern of the genus does not appear to be an anteroposterior development as might be suggested by *carpicinctus* (only neck bands, giving rise to others with body and tail bands) for at least two reasons: (1) a pattern type such as in *carpicinctus* could not give rise to one such as in *venustissimus*, and (2) if it can be assumed that the nuchal collar of many species is a vestigial character, retained from a completely banded condition, and that loss of bands affects the nuchal region last, then the forms of *Scaphiodontophis* with fewest bands are the end forms, while those with the body completely banded are primitive.

In accordance with this arrangement, it may be tentatively proposed that *venustissimus* is the most primitive existing form of its stock. It is not exactly comparable to *cyclurus* (and *zeteki*), because these are common products of a stock which also must have produced a completely banded form with a nuchal pattern like that of *annulatus et al. S. cyclurus* (and *zeteki*) are accordingly comparable to a hypothetical form (X), and these three form a unit comparable to *venustissimus*.

As shown in the accompanying diagram, the X-stem produced the *annulatus* division of the genus, while the *cyclurus-zeteki* stem produced the so-called *zeteki* division. While *cyclurus* and *zeteki* are widely separated geographically, they have differentiated amazingly little. The other forms of the division (*albonuchalis, nothus*) seem to have resulted from the *cyclurus* sections, in the north, while the *zeteki* section in the south apparently remained more stable. The stability of the *zeteki* section may have been influenced by the presence of the X stock.

FIG. 4. Distribution of the species of *Scaphiodontophis*.

KEY TO *Scaphiodontophis*

1. No bands on body or tail; body nearly uniformly colored, not with red; 181 ventrals ..... *sumichrasti*
   Bands present at least on body; triads separated by red; ventrals 157 or less 2
2. Triads two black bands enclosing a white (yellow) 3
   Triads two yellow bands enclosing a black, on body and tail ..... *venustissimus*
3. Black head cap followed by a red area (sometimes narrow), then a pair of black bands (enclosing a white) 4
   Black head cap followed in succession by a white band, a single black band, and a longer red band 6
4. Black bands few (two pairs in type), restricted to neck ..... *carpicinctus*
   Black bands more numerous (5 to 11 pairs), extending about to middle of body ... 5
5. No black spots on scales of red interspaces ..... *annulatus hondurensis*
   Black spots on scales of red interspaces ..... *annulatus annulatus*
6. Tail not banded; all or part of body banded 7
   Tail banded, as well as all of body 8
7. All of body banded ..... *nothus*
   Anterior third or half of body banded ..... *albonuchalis*
8. Snout white ..... *zeteki*
   Snout black, followed by a light interocular band ..... *cyclurus*

Scaphiodontophis sumichrasti (Bocourt)

?*Masticophis* Sumichrast, Bull. Soc. Zoöl. France, vol. 5, 1880, p. 183 (States: "indéterminé;" "de Cocopriets, près Tapana"); *idem.*, La Naturaleza, vol. 5, 1882, p. 285 ("de Cacoprieto, cerca de Tapana").

Henicognathus sumichrasti Bocourt, Miss. Sci. Mex., Rept., livr. 10, 1886, pp. 628-630, pl. 41, fig. 5 ("Cocopriets" [isthme de Tehuantepec]; "Le type de l'Henicogn. Sumichrasti a été adressé au Muséum par F. Sumichrast, sous le nom générique de Masticophis.").

Rhadinaea sumichrasti Cope, Bull. U. S. Nat. Mus., no. 32, 1887, p. 79.

Polyodontophis sumichrasti Boulenger, Fauna India, Rept., 1890, p. 302 (listed); *idem*, Cat. Snakes Brit. Mus., vol. 3, 1896, p. 597 (listed); Werner, Zoöl. Jahrb., vol. 57, 1929, pp. 7, 8 (key).

Ablabes sumichrasti Günther, Biol. Centr. Amer., Rept., 1893, p. 105 (listed, with synonyms).

Sibynophis sumichrasti Dunn, Occ. Papers Bost. Soc. Nat. Hist., vol. 5, 1930, p. 330 (key).

Type locality. Cacoprieto, Oaxaca.

Specimens examined. None.

A free translation of the type description follows:

Diagnosis. Head to snout straight, the profile feebly arched; body slender; eye large, six temporals; nine upper labials, the fourth, fifth and sixth bordering eye; ten lower labials; two pairs of chinshields, moderately developed; scales smooth, in sixteen longitudinal series; a large nuchal spot, bordered behind with yellow; trunk olivaceous with three brown stripes; dentition isodont.

Description. Rostral moderately large; frontal and supraoculars a little shorter than in *Henicognathus annulatus;* parietals moderately developed; eye surrounded by seven scales including one preocular and two postoculars; nine upper labials; the first six are rather elongate, the seventh and eighth are triangular; the ninth well developed and rounded behind; six temporals on the left, seven on right side; ten lower labials; the first five touch the first pair of chinshields. A pair of gular scales following chinshields, in turn followed by 181 ventrals; anal divided; tail long, comprising about one third the total length of the animal. Caudals, 112, divided; scales smooth, forming seventeen rows in the middle of the body.

Measurements. Total length, 128 mm.; snout to vent, 357 mm.; length of tail, 171 mm.

Color. Head olivaceous with numerous blackish flecks on top and sides of snout, forming at level of eyes a deep black transverse band; parietals flecked with black and bordered posteriorly with a large nuchal spot of same color which extends upon the temple; upper labials blackish on their upper and lower sides, while their median parts are yellowish white; upper part of the body with three, long, brown stripes which are on a ground of deep yellow-olive, touched with brown; middle stripe, of somewhat deeper color, arises at the nuchal spot and continues upon the body as a series of small brown spots, more or less clearly defined; each of the lateral stripes begins at the angle of the mouth and disappears almost entirely about the middle of the body; ventral surfaces are of a yellowish-white relieved upon the chin and throat by numerous small brown spots; ventrals with small spots on each side forming two longitudinal lines from the middle of body to extremity of tail.

Remarks. The type specimen remains unique, despite the fact that more than 54 years have elapsed since its discovery. Bocourt states that the type was sent to the museum by F. Sumichrast, under the name of *Masticophis,* as coming from "Cacoprieta, isthme de Tehuantepec." Sumichrast, in papers published in 1880 and 1882, in French and Spanish (*op. cit.*) lists a "*Masticophis* (indéterminé) de Cacoprieta près Tapana" in the French paper, and "*Masticophis* de Cacoprieto cerca de Tapana" in the Spanish paper.

As the snake so identified by Sumichrast is placed in the list following *Bascanion mentovarium,* and preceding *Drymobius margaritiferus*—and not near *Coniophanes,* which it resembles, nor with *Henicognathus,* in which genus it was placed by Bocourt—one wonders whether the snake mentioned by Sumichrast is the same as the type of *Henicognathus sumichrasti,* or whether the latter was accidentally associated with the *Masticophis* label. Certainly the species resembles, in many of its external features (especially the nearly uniform coloration and light labial stripes), the oriental members of the genus *Sibynophis,* and might have had an oriental origin.

Bocourt states that the dentition is isodont, but he likewise places certain forms of *Rhadinaea* in the same genus. The markings, too, seem to resemble those of certain *Rhadinaea.* This may have caused Cope (1887) to associate the species with *Rhadinaea,* and Günther (1893) with *Ablabes.* Cope, however, does not consider the species in his treatment of *Rhadinaea* in 1900 (Ann. Rept. U. S. Nat. Mus., 1898). Certainty as to whether the species should be associated with *Scaphiodontophis* must await a careful study of the dentition of the type, which at this time (1943) is apparently not feasible. If it is properly associated with this genus, it possibly represents the most primitive species. It has the highest ventral count of the genus, and if the tail is complete it appears to have a shorter tail and fewer subcaudals than other *Scaphiodontophis.*

Scaphiodontophis venustissimus (Günther)

(Text fig. 5)

Henicognathus venustissimus Günther, Biol. Centr. Amer., Rept., 1894, p. 144, pl. 51, fig. c (entire, in color); Boulenger, Cat. Snakes Brit. Mus., vol. 3, 1896, p. 598 (redescription); Andersson, Medd. Göteborgs Mus. Zoöl., Afd. 9, 1916, p. 26 (not seen; *fide* Werner, = *annulatus*); Werner, Zoöl. Jahrb., vol. 57, 1929, p. 8 (key); Dunn, Occ. Papers Boston Soc. Nat. Hist., vol. 5, 1930, pp. 329, 330 (key) (Bluefields, Nicaragua; Río Banana, Bonilla, Columbaria, and Zent in Costa Rica); Amaral, Mem. Inst. Butantan, vol. 7, 1932, pp. 107-109 (Muzo, Colombia).

Type locality. Hacienda Santa Rosa de Jericho, 3250 ft., Matagalpa, Nicaragua.

Specimens examined. Two.

Type description. "Form of the body and head as in *Coronella annulata* [=*Lampropeltis annulata*], but with a stronger and longer tail. Frontals together a little shorter than the vertical, which is nearly as long as an occipital. Loreal rhombic; one praeocular, just reaching the upper surface of the head; two postoculars, both in contact with the occipital. Temporals 2 + 2. Nine upper labials, the fourth, fifth and sixth entering the orbit. Chin-shields nearly of the same length. Scales in 17 rows. Ventrals 145; anal divided. Maxillary teeth of equal size, small, 43 in number. Coral-red or

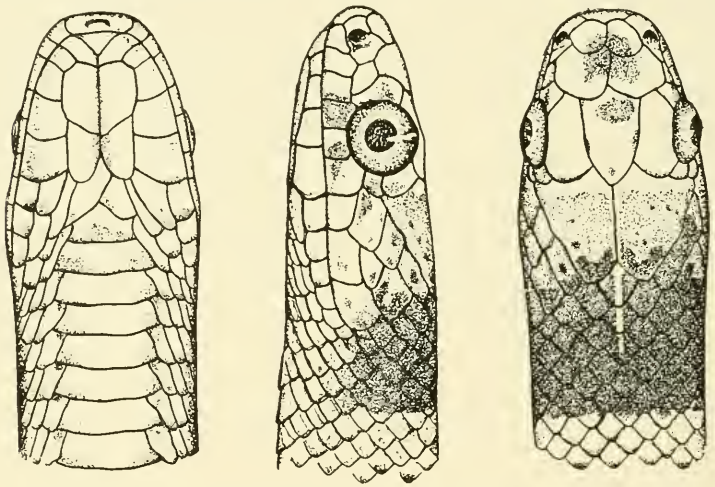


FIG. 5. Head of *Scaphiodontophis venustissimus,* from U. S. N. M. No. 37346, Bluefields, Nicaragua.

reddish-olive, with more or less irregular, broad, black, white-edged rings. The black rings encroach but slightly upon the abdomen. Head and neck black, with a broad white interocular band; the anterior two black body-bands are complete, but the following (eight or nine in number) are broken in the middle of the back; they are complete again on the tail. Each scale of the red spaces with a black tip. Lower parts whitish, with some blackish spots, irregularly crowded towards the sides of the abdomen. Each subcaudal with a large black spot.

"I have seen two specimens, both with mutilated tails; the larger measures 17 inches, without tail."

Remarks. Two specimens examined (U. S. N. M. No. 67350 ♀, Columbaria, Costa Rica; No. 37346 ♀, Bluefields, Nicaragua) pre-

sent the following data, respectively: ventrals, 152, 150; anal divided; double subcaudals, 96, 25 (tips of tails missing); scale rows 19 about head, 17 throughout body, in both; supralabials 9-9, 9-9; infralabials 10-10, 9-9; temporals $1+2+2$ in both; preoculars 1—1; postoculars 2—2, the lower largest in each case. In No. 67350 the snout is blackish or blackish brown, somewhat lighter in the interorbital region, followed by a large black spot occupying the posterior three fourths of the parietals and including first six or seven scale rows on neck; this followed by a yellowish band of about five scale lengths. There follow about 8 triad bands (white-black-white) on the body, which is reddish (in life), each scale marked with a black apical spot; four triads are broken medially and the halves alternate on middle of body; six triads on tail.

No. 37346 is a little larger. The snout is lighter anteriorly and the interocular band is more distinct. There are 11 triads on body and 2 on the tail (the greater portion of which is missing). Seven triads are broken medially, including the first. In both there are distinct black spots on inner edges of each of the divided subcaudals.

Scales of the head with numerous fine "pits" especially on the supraoculars, frontals and the posterior part of the parietals; scales in the neck region with from one to 5 "pits," visible on scale even when epidermis is removed.

Boulenger gives length of type 430 mm. without tail, and the ventral counts of two cotypes as 142 and 137.

The dentition of U. S. N. M. 67350 and 37346 is as follows: Maxillary teeth, 56, 56, smaller anteriorly and posteriorly, the median teeth larger, all arranged in diads and triads of unequal size; all teeth spatulate, with their tips brownish. A dorsal process on maxillary as well as a medial ectopterygoid process. Palatine teeth 25, 30; pterygoid 25, 30; dentary 54, 58.

The low maxillary count (43) given by Günther seems very likely in error, and his statement that the teeth are equal may be due to faulty observation.

Scaphiodontophis annulatus annulatus (Duméril and Bibron)

(Plate XXI)

Enicognathus annulatus Duméril and Bibron, Erp. Gén., vol. 7, 1854, pp. 335-336, pl. 80; Günther, Ann. Mag. Nat. Hist., ser. 4, vol. 1, 1868, p. 418; Sumichrast, Bull. Soc. Zoöl. France, 1880, p. 181 (*part.*); *idem*, La Naturaleza, vol. 5, 1882, pp. 269, 284 (*part.*); *idem*, vol. 6, 1882, p. 42 (*part.*).

Henicognathus annulatus Cope, Journ. Acad. Nat. Sci. Phila., ser. 2, vol. 8, p. 138 (generic relationships); Bocourt, Miss. Sci. Mex., Rept. livr. 10, 1886, pp. 626-628 (*part.*); Cope, Bull. U. S. Nat. Mus., No. 32, 1887, p. 79 (*part.*; Cobán; Belize); Günther, Biol. Centr. Amer., Rept., 1893, p. 107 (*part.*; Vera Paz, Guatemala).

Diadophis annulatus Garman, N. Amer. Rept., 1883, p. 70.

Polyodontophis annulatus Boulenger, Fauna British India, Rept., 1890, p. 302; *idem,* Cat. Snakes Brit. Mus., vol. 1, 1893, p. 189 (City of Mexico [!], Vera Paz); ?Werner, Verh. Zoöl. Bot. Ges. Wien, vol. 46, 1896, p. 352; *?idem,* Abh. Akad. München, 1903, p. 345; *idem,* Zoöl. Jahrb., vol. 57, 1929, pp. 7-8 (*part.*).

Sibynophis annulatus Dunn, Occ. Papers Boston Soc. Nat. Hist., vol. 5, p. 330 (*part.*).

Type locality. Cobán, Alta Verapaz, Guatemala.

Specimens examined. Four: U. S. N. M. 32598, Belize, British Honduras; U. S. N. M. 35915-7, Alta Vera Paz, Guatemala.

Diagnosis. Black head cap followed by a short red space, then by a triad consisting of a pair of black bands enclosing a white band; a total of five to eleven such triads, occupying half or third of body; ventrals 137 to 157.

Description. A very free translation of the original description follows:

FORM. Tail strong and robust, equal to about half the length of the trunk. Upon the anterior fourth of the back, five double black rows appear upon a reddish ground lighter than the remainder of the body, where one sees, along the median line of the body, a series of black dots in zigzag, especially apparent toward the beginning of the tail. The posterior two-thirds of the head completely black.

SCUTELLATION. By the size and the length of the tail [the unique specimen in the Museum of Paris lacks the extremity of the tail] this species is very distinctly distinguished from its congeners. The eye is proportionately much larger, the head is slightly more convex above, and the snout is truncate, elongate, and slightly sloping above. The nine plates on the top of the head are normal. The rostral much enlarged, reaching to the top of the snout, the upper edge strongly curved. The loreal is small, lower behind than in front, where it is in contact with the outer edge of the frontal. The preocular single and large; two postoculars. Eight upper labials; the fourth and fifth, which are very large, border the orbit. Between the last upper labials and posterior edge of the parietal, five temporals of medium size. The lower labials are about the same size and carried posteriorly. Scales lozenge-shaped, in seventeen rows. Ventrals 142; anal divided; 74 divided caudals (tip of tail missing).

COLORATION. The general color of the dorsal regions is brown, tending toward green. The head, at the level of the posterior extremity of the supraocular and frontal, is deep black, which extends up to the nape of the neck and is broken by the line of junction of parietals, between which one sees a light color which is present also in the form of a regular spot in the temporal region. This color is

present also on the anterior part of the head. On the under side of the orbit three black spots begin. The middle one, smaller than the others, reaches the upper lip directly while the others are directed obliquely, one anteriorly, the other posteriorly. Upon the nape of the neck, behind the large black spot, the coloration is light, somewhat roseate, forming a sort of collar, and bordered behind by a transverse black bar; this in turn is separated by a light bar from a second black bar. From here on, at intervals becoming slightly greater and at the distance of from eight to nine millimeters, one sees four pairs of black bars, arranged like the preceding. The remainder of the back and all the tail are of a brown color, much darker than the ground color previously described. Upon this one notices three parallel series of black spots, scarcely noticeable anteriorly but becoming larger posteriorly, particularly along the median line where the spots of the three series touch and form a succession of small, angulated, transverse spots. On the ventral surface one finds small black flecks on the outer edges of each ventral and caudal.

MEASUREMENTS. The head and body, 390 mm.; tail (tip missing), 200 mm.; total length, 590 mm.

Variation. The four specimens in the National Museum (see above), all males, have the following ventral and caudal counts, respectively: No. 32598, 140, 142; No. 35915, 143, ?; No. 35916, 147, ?; No. 35917, 145, 132. Supralabials nine in all, fourth, fifth and sixth entering orbit; infralabials 10-10 in one, 10-11 in two, 11-11 in one; preoculars 1-1, postoculars 2-2 in all; seventh labial in contact with lower postocular on both sides in two, on one side in one, on neither side in one; two labials in contact with posterior chinshields in all. All three Vera Paz specimens have the paired bands set close together, separated by red interspaces covering two and a half to six scale lengths. Two of them have five pairs of black bands, while one has eleven. The latter has no dark spots on the red areas, and in the others there are but few spots. They are not typical *annulatus* (as figured by Duméril and Bibron), of which the Belize specimen is an excellent example. In this there are six and one-half bands, the red bands cover six to nine scale lengths, and all scales in the red areas are black-tipped. The Alta Vera Paz specimens may be intermediate between *hondurensis* and typical *annulatus*.

The hemipenis of No. 35917 is eleven caudals long, not everted; terminal portion (two caudals) calyces, not capitate; calyces ex-

tending proximally a short distance along sulcus; latter single; spines straight (very slightly curved at tip), increasing in size proximally, in diagonally placed rings interrupted at sulcus; two proximal spines very large; spines covering the length of three and one-half caudals; basal portion ridged.

Four specimens which Müller had available (*loc. cit.*), from Guatemala, apparently belong to *albonuchalis*.

Werner (1896, *op. cit.*) gives data on a male specimen, which may be this species (or may be *albonuchalis*), from Guatemala. Internasals only somewhat shorter than the prefrontals, and the count of the double subcaudals is even greater than the largest given by other specimens: ventrals 143, subcaudals 145. Total length, 612 mm.; tail, 289 mm.

Scaphiodontophis annulatus hondurensis (Schmidt)

Sibinophis (sic) *annulatus* Barbour and Loveridge, Bull. Antiv. Inst., vol. 3, 1929, p. 3 (Progreso, Tela Division, Honduras).

Sibynophis annulatus hondurensis Schmidt, Proc. Biol. Soc. Wash., vol. 49, 1936, pp. 48-49.

Type locality. Portillo Grande, Yoro, 4100 ft. altitude, Honduras.

Specimens examined. None.

"*Diagnosis.* In close agreement with *Sibynophis annulatus annulatus* in scale characters, but with the pairs of dark crossbars on the anterior part of the body set close together, and without black spots on the scales of the red interspaces.

"*Description of type.* Rostral wider than high, well visible from above; upper head shields normal; parietals extending to the lower postocular; nostrils between two nasals; loreal about as high as long; nine upper labials, the fourth, fifth, and sixth entering the eye; ten lower labials; oculars 1-2; temporals $1 + 2 + 2$; dorsal scales in seventeen rows; ventrals 145, anal divided, caudals 149.

"A white band across the snout, in front of the eyes, rest of head black; five pairs of narrow black crossbars, separated by gray spaces of about the same width, the first of which is four scales behind the parietals; intervening spaces dark red, the scales clouded, but without black apical spots; posterior part of the body brownish gray above, with three rows of spots, one on the mid-dorsal line and a pair on the fifth scale rows; underside uniform light, the ends of the ventrals with black spots.

"*Measurements.* Total length, 617 mm.; tail, 295 mm."

Remarks. Schmidt was fortunate in having available several paratypes, from the type locality and in addition from Subirana Valley (2800 ft.) and Tela, Honduras. He points out, however, a

very considerable variation in the ventral counts of the male specimens and presents the following data: males, ventrals 128 to 142, caudals 132 to 137; females, ventrals 153 to 156, caudals 128 to 132. The largest male and female specimens are as follows: total length, 739 mm.; tail, 350 mm.; total length, 782 mm.; tail 336 mm.

We retain this name, although National Museum specimens from Alta Verapaz are intermediate between this and typical *annulatus*.

Scaphiodontophis carpicinctus sp. nov.

(Plate XXII, fig. 1; text fig. 6)

Holotype. U. S. National Museum No. 110411, male, Piedras Negras, Guatemala, June 3, 1939.

Diagnosis. Only neck banded; black head cap followed in succession by a red space, a pair of black bands, a longer red space, and a final pair of black bands; remainder of body and tail gray; five dotted dark lines on body; three zigzag lines on tail.

Description of holotype. Head not depressed, somewhat distinct from neck; snout slightly truncate; rostral more than one and one-half times as broad as high, the portion visible from above about half length of internasals; latter about two thirds size of prefrontals, which extend onto sides of head to a point about on a line between middle of orbit and upper edge of naris; length of frontal (4.8 mm.)

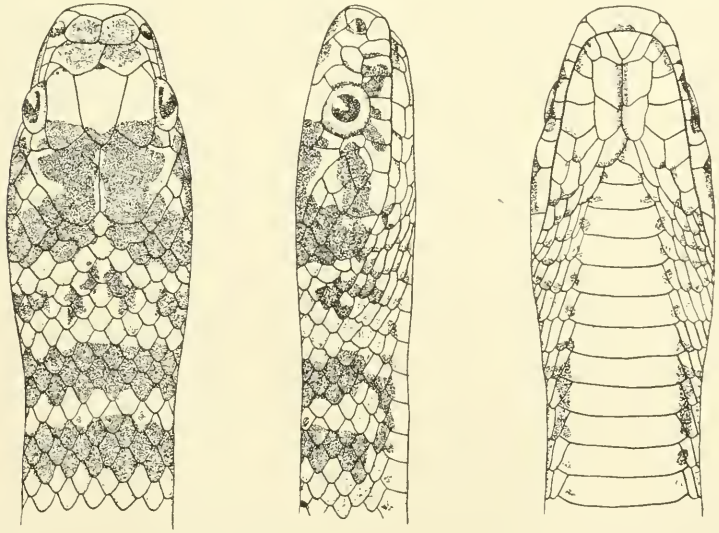


FIG. 6. Head of *Scaphiodontophis carpicinctus*, from the holotype U. S. N. M. No. 110411, Piedras Negras, Guatemala.

much greater than its distance from tip of snout (3.2 mm.) or length of interparietal suture (3.8 mm.), less than greatest length of parietal (5.3 mm.); supraocular and frontal subequal in length, latter somewhat the larger; nasal completely divided, naris occupying most of its width; anterior section of nasal lower than posterior, somewhat larger; loreal single, nearly square; a large preocular; two subequal postoculars; temporals 1 + 2 + 2, the anterior separated narrowly from parietal on one side, somewhat wedged between seventh and eighth labials, not in contact with sixth labial nor with upper postocular; secondary temporals smallest, about as long as broad; tertiary temporals elongate; nine supralabials, fourth, fifth and sixth entering eye, ninth largest; eye large, its diameter (3.1 mm.) three fourths its distance from tip of snout (4.2 mm.); ten infralabials, the first in contact medially with its mate, four in contact with anterior chinshields; posterior chinshields two thirds size of anterior, in contact with two infralabials (fourth and fifth).

Scales in 17 rows throughout, smooth, without apical pits; ventrals 140; anal divided; caudals more than 102 (tail tip missing); total length 545 mm.; tail 228 mm.

Maxillary teeth, 54; 25 palatine, 23 pterygoid, 51 dentary teeth.

Hemipenis about eleven caudals long, not everted; distal portion (three caudals) calyces, not capitate, but slightly bilobed; calyces extending proximally a short distance along sulcus; latter single; larger spines straight, smaller ones curved at tip; spines increasing in size proximally, in diagonally placed rings interruped at sulcus; four basal spines large; spines covering the length of about four caudals; basal portion ridged.

Color. Sides and front of snout cream, top black; a white interorbital bar, involving all except posterior edges of frontal and supraoculars; remainder of dorsal surface of head black, except fine white line along interparietal suture; black head cap extending laterally to angle of mouth, including most of last labial, reaching posteriorly two scale lengths behind parietal; postocular black spot present, involving most of primary temporal and parts of lower postocular, eighth supralabial and lower secondary temporal, fused posteriorly with the lateral extension of head cap; a fine black line about orbit, with extension to the third, fourth, fifth and sixth labials.

A red nuchal collar covering about four scale lengths, extending laterally about even with angle of mouth, with scattered dark spots (about half the scales black); a paired black ring follows, each component covering about two scale lengths and separated from each

other by a white band covering one scale length; following this, a red space of five to five and one half scale lengths; a few scales in this area with black tips; a broader black ring (of more than two scale lengths) follows, a white ring of one scale length, and finally a narrow black ring covering about one scale length. The dorsal markings extend to the second scale row; the first row is gray, stippled; remainder of dorsal surface gray; five lines, one on the median, and one on the fifth and second scale rows of each side; these lines formed by a black tip on each scale of the row they follow; other dorsal scales with finer black tips, not forming lines; the lines on the median and fifth scale rows form zigzag lines on the tail.

A considerable area at ends of ventrals pigmented; in addition, an irregular dark spot at the posterolateral edge of each ventral, even those in gular region; similar spots on ends of subcaudals, these extending farther medially; a black line on median suture between chinshields; several black flecks on infralabial and gular scales; otherwise ventral surface white.

Remarks. This species is perhaps most closely related to *annulatus* since it possesses a red nuchal collar. The paucity of bands, more extensive black subocular marks, fusion of postocular dark spot and presence of dark marks in the gular region distinguish it from *annulatus*.

Scaphiodontophis zeteki (Dunn)

Sibynophis zeteki Dunn, Occ. Papers Boston Soc. Nat. Hist., vol. 5, 1930, pp. 329-330.

Type locality. Ancon, Canal Zone, Panamá.

Specimens examined. None.

Diagnosis. "Close to *S. venustissimus* of Nicaragua and Costa Rica, but with light instead of black snout, and with black rings in contact with the red bands instead of light."

Description. "Female: scales 17; ventrals 142; anal divided; caudals 65+; oculars 1-2; temporals 2-2; supralabials 8; infralabials 10; third, fourth and fifth supralabials in contact with eye; four infralabials in contact with anterior chinshields which are much longer than those posteriorly; snout white; black dots on the labials under the eye; parietals and nape black; black dots on postoculars, temporals, and last labial; a light ring two scales long followed by a black ring 1½ scales long back of nape; this followed by a red band 9 scales long, the scales tipped with black; then black, yellow, black, each ring two scales long; then red again, etc.; 12 red bands

on body, varying in length from 9 to 3 scales; tail with three broad red bands separated by three black rings which are in turn separated by light rings; the combination about equal to one red band, and being made up in about the proportion of 1 black, 1 yellow, 6 black, 1 yellow, 1 black; throat and belly light; a black dot on each subcaudal; length 531 mm.; tail 166 mm., imperfect."

Remarks. This species may be closely related to *Scaphiodontophis cyclurus*, but this cannot be determined positively until the dentition is examined.

Scaphiodontophis cyclurus sp. nov.

(Plate XXII, fig. 2; text fig. 7)

Holotype. EHT-HMS No. 23618, male, Cuautlapan, Veracruz, June, 1940.

Diagnosis. Entire body and tail banded (terminal portion of tail missing); eight and a half bands on the body and four (plus) on the tail; head black with a dim band between eyes and a nuchal white band two and a half scales wide, followed by a black band one and a half scales wide; the latter followed by a red band sixteen scales wide, each scale with a black tip, and this band followed by a black, yellow, black band totaling from four and a half to five scales in width; two outer scale rows grayish, the color extending somewhat onto ventrals; venter otherwise without markings.

Description of holotype. Head not depressed, sloping from interorbital regions to snout, somewhat distinct from neck; snout slightly

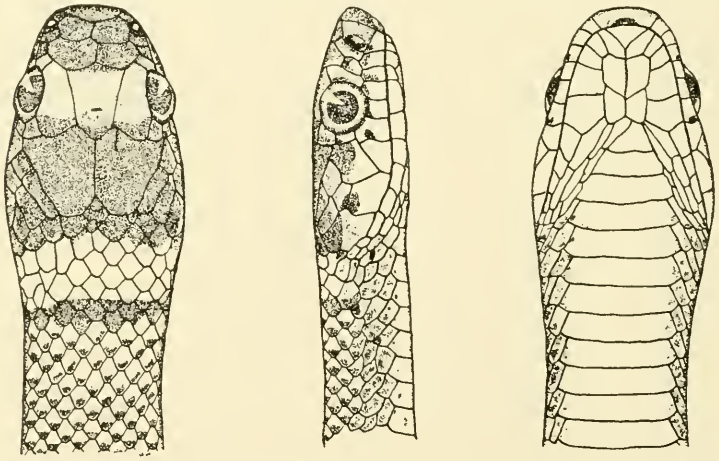


FIG. 7. Head of *Scaphiodontophis cyclurus*, from the holotype EHT-HMS No. 23618, Cuautlapan, Veracruz.

truncate; rostral one and a half times as broad as high, the part visible from above less than half the distance from the frontal; internasals much smaller than prefrontals; latter more or less curving posteriorly; length of frontal (4.3 mm.) about one-fourth greater than its distance from tip of snout (3.7 mm.); length of the interparietal suture (3.7 mm.) less than greatest parietal length (5.8 mm.); supraoculars about as long as frontal; nostril between two nasals; anterior nasal large, somewhat rectangular, and lower than posterior nasal; loreal large, irregular, its greatest anteroposterior length greater than its height, sharply angular behind; a large preocular and two postoculars, of which the upper is largest; temporals $1+2+2$; primary temporal forming a deep notch between the seventh and eighth labials, touching sixth labial; secondary temporals small, their combined size less than the primary; tertiary temporals much elongated; 9 supralabials, fourth, fifth and sixth bordering orbit, the ninth largest, its posterior border curving; eye large, its length (3.5 mm.) equal to its distance from anterior end of the nasal; distance from eye to tip of snout 4.5 mm.; nine infralabials, the four anterior in contact with the anterior chinshields; posterior chinshields somewhat more than half area of anterior, in contact medially, each touching two infralabials; mental much narrower than rostral.

Scales in 17 rows from parietals to anus; dorsals smooth, without pits; ventrals 141, anal divided; subcaudals 37+, the tip of the tail missing; total length 402 mm.; body, 315 mm.; tail, 87 mm. (incomplete).

Color. Snout to ends of the prefrontals black; a grayish brown bar extends between the eyes and somewhat down in front of them; a broad black band extending from the posterior parts of frontal onto the first row of body scales, covering the parietals and posterior and tertiary temporals; a black spot on anterior temporal; small black spots on several of the labials, which are for the most part cream color; a stippled area above the postocular spot; a narrow black ring surrounding orbit; a white nuchal collar two and one-half scales wide follows the black spot and reaches down to the level of the last upper labial; this followed by a broad red band which extends to the ventrals, each scale with an apical blackish spot covering one-third to one-half of the scale; then follows a triad consisting of black, yellow, black bands, whose total width is four and one-half scale lengths; there follow three triads, equally spaced, separated by wide red areas; the next bands are broken so that on

the left side there are three half bands which alternate with two half bands on the right; one other complete band follows anterior to the base of the tail. Tail with four bands separated by diminishing reddish bands (the tip of the tail missing); two outer scale rows and edges of ventrals stippled with gray; venter without markings; slight dark clouding on the chin.

Remarks. The teeth of this species conform with the generic characters. There are 54-54 spatulate teeth on the maxillary, arranged in diads or triads of unequal size, every second or third tooth longer and larger than adjoining teeth; tips of all teeth not in line, but tips of teeth of each triad (or diad) in a diagonal row. On dentary, 49 teeth, usually every second tooth enlarged.

The hemipenis is eleven caudals long, not everted; terminal portion (two caudals) calyces, capitate; calyces extending proximally a short distance along sulcus; latter single; spines straight, increasing in size proximally, in diagonally placed rows interrupted at sulcus; four proximal spines larger than others; spines covering the length of four scales; basal portion ridged.

Ferrari-Perez (Proc. U. S. Nat. Mus., vol. 9, 1886, p. 188) lists *Henicognathus annulata cyclura* Cope M. S. subsp. nov., type locality Jicaltepec (Jalapa), Vera Cruz. So far as we know no other publication was made and accordingly the name appears to be a *nomen nodum*. We are not now certain whether Cope had a specimen of this or another form before him.

Scaphiodontophis nothus sp. nov.

(Plate XXIII, fig. 2; text fig. 8)

Holotype. U. S. Nat. Mus. No. 110412, male, Potrero Viejo, Veracruz, March 5, 1932, collected by Dyfrig McH. Forbes.

Diagnosis. Entire body, but not tail, banded; twelve white bands (including nuchal collar) in type; black head cap followed in succession by a white neck band, a narrow black band, a broad red band, and a succeeding series of black, white, black and red bands to end of body; tail gray, with three irregular, zigzag lines.

Description of holotype. Head not depressed, somewhat distinct from neck; snout slightly truncate; rostral one and one-half times as broad as high, the portion visible from above about two-thirds maximum length of internasals; latter about two thirds size of prefrontals, which extend onto sides of head to a point about on a line between middle of orbit and upper edge of naris; length of frontal (5 mm.) greater than its distance from tip of snout (3.5 mm.) or

length of interparietal suture (3.9 mm.), less than maximum length of parietal (5.6 mm.); supraocular and frontal of subequal length, latter somewhat the larger; nasal completely divided, naris occupying most of its width; anterior section of nasal somewhat lower than posterior, slightly larger; loreal large, subrectangular; a large preocular; two postoculars, lower slightly the smaller; temporals 1 + 2 + 2, but the two secondary temporals fused to form one scale on one side; primary temporal in contact with parietal and lower postocular, separated from sixth labial, and wedged between seventh and eighth labials; secondary temporals small, as broad as long;

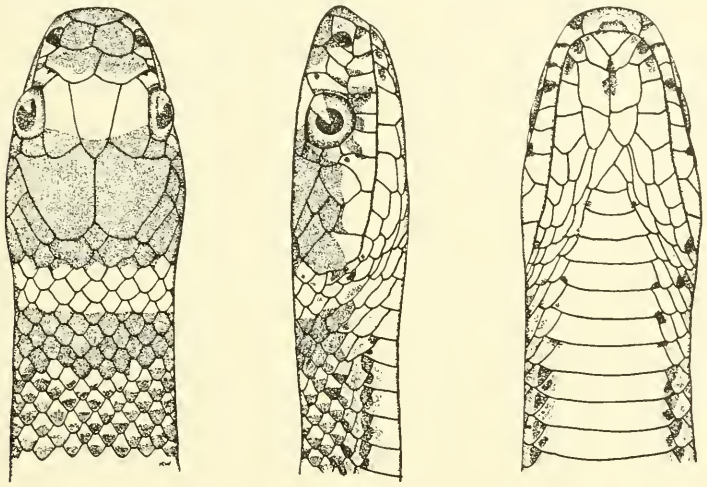


FIG. 8. Head of *Scaphiodontophis nothus*, from the holotype U. S. N. M. No. 110412, Potrero Viejo, Veracruz.

tertiary temporals elongate; nine supralabials, fourth, fifth and sixth entering eye, ninth largest; eye large, its diameter (3.2 mm.) more than half its distance from tip of snout (5 mm.); ten infralabials, the first in contact with its mate medially, four in contact with anterior chinshields; posterior chinshields two thirds size of anterior, in contact medially and with two infralabials (fourth and fifth).

Scales in 17 rows throughout, smooth, not pitted; 141 ventrals; anal divided; caudals more than 74 (tip of tail missing); total length, 531 mm.; tail, 187 mm.

Maxillary teeth 52; 23 pterygoid, 26 palatine, 56 dentary teeth.

Hemipenis ten caudals long, not everted; terminal portion (two caudals) calyces, apparently slightly capitate; calyces extending

proximally a short distance along sulcus; latter single; spines straight, increasing in size proximally, in diagonally placed rings interrupted at sulcus; four proximal spines largest; spines covering length of four scales; basal portion ridged.

Color. Snout to ends of prefrontals black, with extensive light areas on sides; a white interorbital bar involving all of frontal and supraoculars except posterior tips; remainder of dorsal surface of head black, the color extending onto neck about one scale length, and laterally onto sides of head as far as lower edge of ninth supralabial; a postocular black spot, fused with lateral extension of black head cap; a dark gray, stippled area above postocular spot, involving edge of parietals and adjacent scales on either side; a narrow black ring around orbit, less distinct on postoculars, with extensions onto subocular and third supralabials; posterior edge of loreal and posteromedial edge of second supralabial black.

A white nuchal collar covering about two scale lengths, the first of a series of twelve white crossbars, the last immediately preceding anus, three of which are broken medially, the half crossbars staggered (alternating); white crossbars cover one and one half to three scale lengths on the midline, but are narrower laterally, covering one scale length or less; black borders are wider than the white crossbars, covering one and a half to three scale lengths, also narrowing somewhat on sides of body; red bands covering about five to eleven scale lengths, becoming shorter on posterior part of body; a large area at tip of each scale in red bands, black; red bands somewhat longer laterally than medially; all dorsal markings terminating on second scale row; first scale row and ends of ventrals gray, stippled, but no distinct black spots on ends of ventrals; ends of subcaudals also stippled, the color extending medially more than half the width of each scale; a few indistinct dark markings in gular region; otherwise ventral surfaces white. Dorsal surface of tail gray, with three zigzag, somewhat irregular dark lines.

Remarks. This snake is generally known in the region of the type locality as "rabo de hueso." The bite is erroneously believed to cause death by paralysis of the neck muscles; they are unable to control the movements of the head, which sooner or later displaces the neck vertebrae. (We are aware that the name is applied to other species of snakes, elsewhere.)

Scaphiodontophis albonuchalis sp. nov.

(Plate XXIII, fig. 1; plate XXIV; pl. XXV, figs. 1, 2. Text fig. 9)

Enicognathus annulatus Jan, Arch. Zoöl. Anat. Fis., vol. 2, 1863, p. 778; Jan, Elenco Sist. Ofidi, 1863, p. 51; Jan and Sordelli, Icon. Gen., Livr. 16, 1866, pl. 4, fig. 3; Müller, Verh. Nat. Ges. Basel, vol. 6, 1878, pp. 565, 659-660 (Costa Grande, Guatemala); Slevin, Proc. Calif. Acad. Sci., ser. 4, vol. 23, 1939, pp. 396-397.

Henicognathus annulatus Bocourt, Miss. Sci. Mex., livr. 10, 1886, pp. 626-628 (*part.*), pl. 40, fig. 6; Cope, Bull. U. S. N. M., no. 32, 1887, p. 79 (*part.*; Tabasco); Günther, Biol. Centr. Amer., Rept., 1893, p. 107 (*part.*; Tabasco, Atitlán, Tehuantepec).

Sibynophis annulatus Dunn, Occ. Papers Boston Soc. Nat. Hist., vol. 5, 1930, p. 330 (*part.*).

Holotype. U. S. National Museum No. 110413, female, La Esperanza, Chiapas (near Escuintla), April 23, 1940. *Paratypes.* EHT-HMS No. 23881, topotype, May 19, 1940; U. S. N. M. No. 12693, Escuintla, Guatemala; No. 12087, "Mexico"; No. 6580, San Juan Bautista, Tabasco; and No. 94 (dried) of the collection of the Minister of Agriculture, San Salvador, from "San Salvador."

Diagnosis. Anterior half of body banded, with six to eight white bands; black head cap followed in succession by a white band, a single black band, a broad red band, and a succeeding series of black, white, black and red bands to middle of body; remainder of body and tail gray; three dark stripes on body and tail, dotted on body, zigzag on tail.

Description of holotype. Head not depressed, somewhat distinct from neck; snout slightly truncate; rostral more than one and one half times as broad as high, the portion visible from above about half length of internasals; latter about two thirds of prefrontals, which extend onto sides of head to a point about on a line between middle of orbit and upper edge of naris; length of frontal (5 mm.) much greater than its distance from tip of snout or length of interparietal suture (3.2 mm.), subequal to length of parietal; supraocular and frontal subequal in length; latter somewhat the larger; nasal completely divided, naris occupying most of its width; anterior section of nasal lower than posterior, subequal in size or slightly larger; a single, somewhat elongate loreal; a large preocular; two postoculars, upper slightly the larger; temporals 1 + 2 +2, the primary wedged between seventh and eighth labials, in contact with only lower postocular, on one side narrowly in contact with sixth labial; secondary temporals smallest, about as broad as long; tertiary temporals elongate; nine supralabials, fourth, fifth and sixth entering eye, ninth the largest; eye large, its diameter (3.2 mm.) more than half its distance from tip of snout (4.9 mm.); ten infralabials, the first in contact medially with its mate, four in contact with anterior chinshields; latter about a third larger than posterior

chinshields, which are in contact medially and with two (fourth and fifth) infralabials.

Scales in 17 rows throughout, smooth, without apical pits; ventrals, 154; anal divided; caudals, 117; total length, 625 mm.; tail, 248 mm.

Color. Snout pale brown on sides and in front, nearly black above; a broad, white interocular bar involving all except posterior tips of frontal and supraoculars; remainder of dorsal surface of head black, except a fine, broken light line on interparietal suture; black

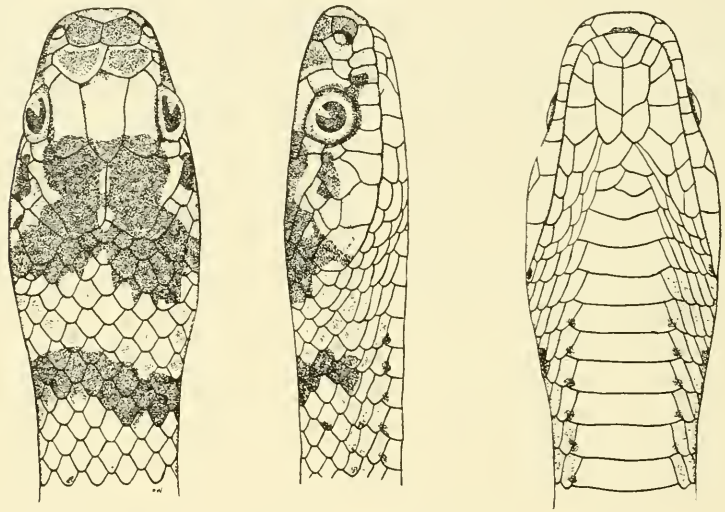


FIG. 9. Head of *Scaphiodontophis albonuchalis*, from the holotype, U. S. N. M. No. 110413, La Esperanza (near Escuintla), Chiapas.

of head extending onto nuchal region about two scale lengths, less on median line, and laterally to angle of mouth; a black spot behind eye, involving most of primary temporal, and parts of adjacent scales; this spot surrounded on all sides by a light area, which is stippled with black except below the spot; a narrow black line surrounding orbit, not very distinct on postoculars, with a projection onto third and fourth labials; otherwise labials white.

A white nuchal collar, with some darker stippling, covering about two and a half scale lengths, immediately following black head cap; this followed by a somewhat narrower black ring extending to the second scale row; a red area eleven or twelve scales long follows, and in turn seven more paired black rings; the red interspaces between the pairs of bands decrease in length posteriorly, the last

covering three scale lengths dorsally, five laterally; anteriorly the dorsal markings, including the red areas, black rings and white interspaces, extend laterally to the second scale row; posteriorly they extend to the fourth or fifth, the lateral scales gray; white spaces slightly wider than the black borders; remainder of dorsal surface gray; a line of dark spots on the tip of each middorsal scale, extending from last ring to tail, and from there to tip of tail as a continuous, zigzag line; posteriorly a similar line of dots on the tips of scales in the fifth row; this also becomes a zigzag line on tail, but less distinct; ends of ventrals stippled with black, more heavily on posterior edges; ends of subcaudals black; otherwise ventral surface white.

Variation. The scutellation of the five paratypes is essentially like that of the holotype. The frontal is generally somewhat broader; two loreals, one above the other, are present in one (end of prefrontals segmented); the anterior temporal is in contact with the sixth labial on both sides in three, on neither side in two. The shape and arrangement of the temporals are peculiarly constant.

The black head cap extends posteriorly one and one-half to four scale lengths, and is nearly straight in some, instead of being indented medially; the light, dark-stippled area above the postocular stripe extends a considerable distance dorsally in one (U. S. N. M. 6580), separated from its mate at posterior edge of parietals about three scale widths; the white bands (including the nuchal band) vary in number from six to eight; in one (U. S. N. M. 12087) the subcaudal black spots extend nearly to the midventral line; the latter condition is nearly approached in two others (U. S. N. M. 6580, 12087). The Chiapas specimens (as well as the dried specimen from San Salvador) have the spots confined to the edges of the subcaudals.

The accompanying table shows variation in scale counts.

Number	Sex	Ventrals	Caudals
110413	♀	154	117
23881	♀	152	...
12693	♀	156	120
94	♀	151	...
6580	♀	158	...
12097	♂	138	...

The teeth conform to the generic characters. There are 55 maxillary, 25 palatine, 24 to 29 pterygoid and 51 dentary teeth; there is a dorsal as well as a medial ectopterygoid process.

Hemipenis of No. 12087 ten caudals long, not everted; terminal portion (two caudals) calyces, not capitate; calyces extending proximally a short distance along sulcus; latter single; spines straight, increasing in size proximally, in diagonally placed rings interrupted at sulcus; four proximal spines largest; spines covering the length of four scales; basal portion ridged.

Four specimens which Müller (*op. cit.*) had available, from Guatemala, have the following scale data: No. 1, 142 ventrals, 125 caudals, 415 mm. total length, 180 mm. tail; No. 2, 143 ventrals, 133 caudals, 630 mm. total length, 300 mm. tail; No. 3, 142 ventrals; No. 4, 140 ventrals. All the specimens have only one preocular; nine upper labials, with the fourth, fifth and sixth bordering the eye (one specimen has eight on one side, the fourth and fifth bordering the eye); infralabials nine or ten, five touching two pairs of chinshields, the fifth largest, the following small; second pair of chinshields somewhat smaller than the first pair; one of the specimens has two loreals on one side, the upper bordering the prefrontal. All four specimens have five double bands behind the neck band which here and there alternate on the middle line; two specimens have the underside of the tail uniformly light, while the other two have the subcaudals sprinkled with brown. Three lines run from the last triad to the tail. The tongue is ringed with white and brown.

Slevin (*op. cit.*) reports two other specimens, presumably of this species, from Finca El Ciprés, Volcán Zunil, Guatemala. One is a male, with 142 ventrals, the other a female with 152 ventrals; tail incomplete in both. Other scale counts are typical, save one that has 10-10 infralabials. Their color is described as follows: "Both specimens are somewhat similar in coloration. The top of the head is black, with a dark grayish transverse band between the eyes. At the base of the parietals begins a series of black bands, divided by one or two rows of grayish scales, and separated from each other by a band of red, nine to ten scales wide. The black bands break posteriorly, forming blotches on a ground color of red. This coloration forms the anterior third of the body, while the remainder is grayish or olive, with or without three longitudinal rows of black spots. Under surfaces yellowish-white, the gastrosteges and urosteges with lateral grayish spots. No. 66968, the female, lacks the posterior spotting and is uniform olive in coloration.

Comparisons. *S. albonuchalis* differs from typical *annulatus* primarily in having the first pair of black rings farther forward on the neck. In *annulatus* both rings of the first pair are visible, and sepa-

rated from the black head cap by a red area, while in *albonuchalis* the nuchal red area is absent, the anterior ring of the first pair of black rings is also absent, and the collar is formed by the first white interspace, rather than by a red area.

Remarks. The two specimens from Chiapas were found during the day in the leaves on the ground in a coffee grove. The type contains a specimen of *Leiolopisma assatum taylori.* Specimens reported by Slevin (*loc. cit.*) were "taken at the edge of a clearing amongst the coffee trees. . . ."

PLATE XXI

Scaphiodontophis annulatus annulatus, U. S. N. M. No. 32598, Belize, British Honduras.

PLATE XXI

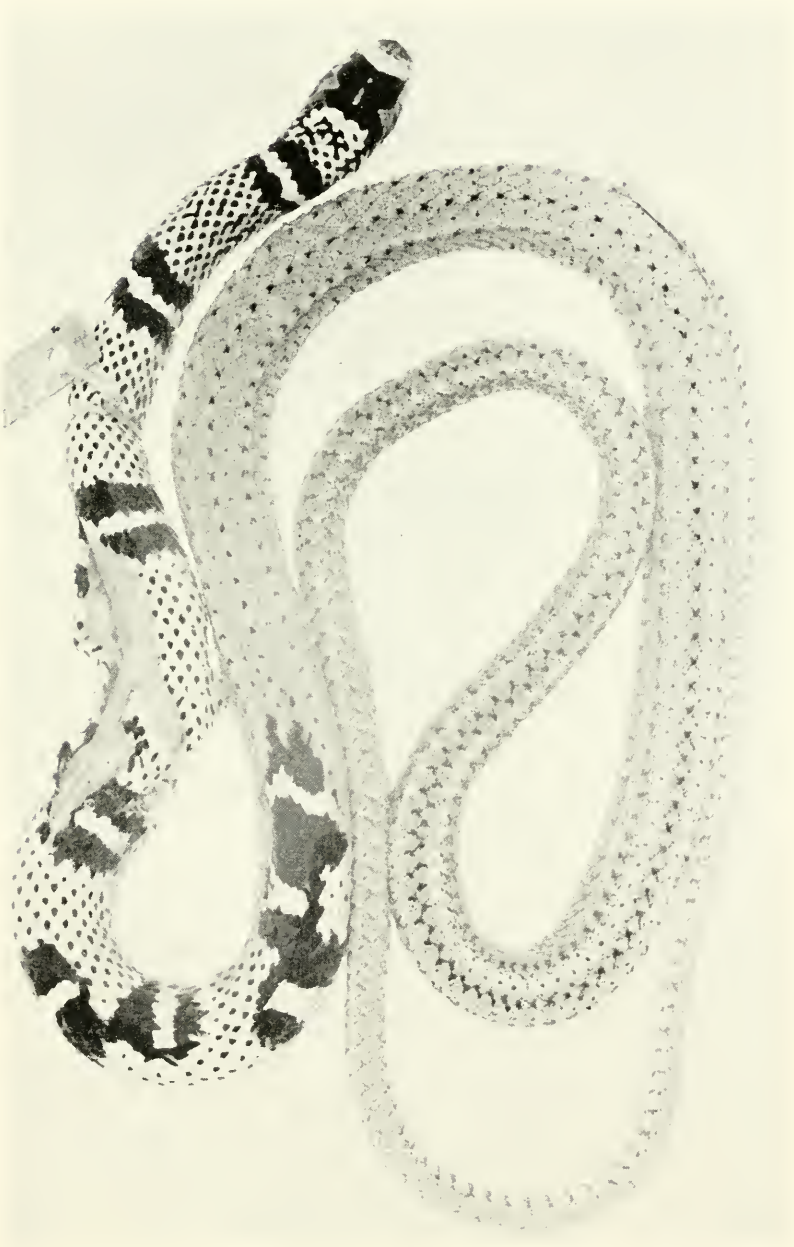


PLATE XXII

FIG. 1. *Scaphiodontophis carpicinctus* sp. nov.; holotype, U. S. N. M. No. 110411, Piedras Negras, Guatemala.

FIG. 2. *Scaphiodontophis cyclurus* sp. nov.; holotype, EHT-HMS No. 23618. Cuautlapan, Veracruz, México.

PLATE XXII

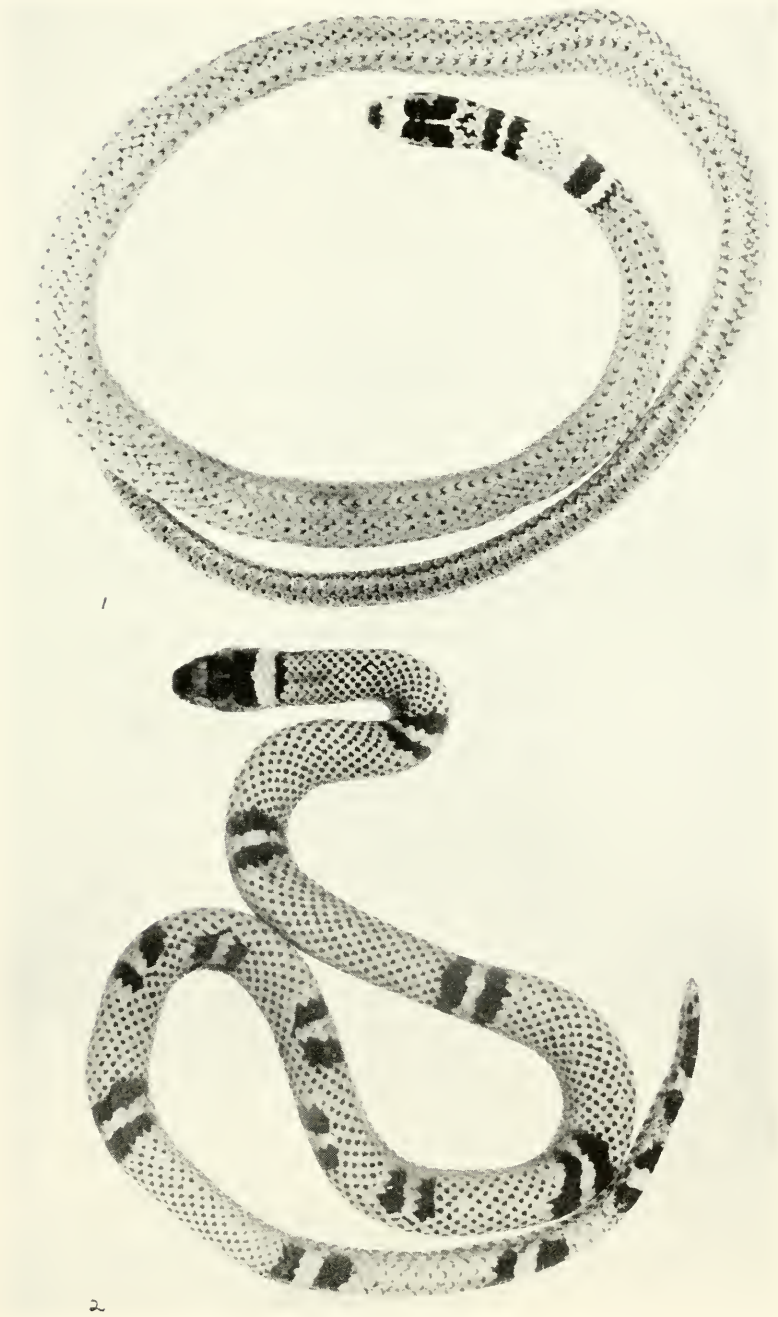


PLATE XXIII

FIG. 1. *Scaphiodontophis albonuchalis* sp. nov.; holotype, U. S. N. M. No. 110413, La Esperanza (near Escuintla), Chiapas, México.

FIG. 2. *Scaphiodontophis nothus* sp. nov.; holotype, U. S. N. M. No. 110412, Potrero Viejo, Veracruz, México.

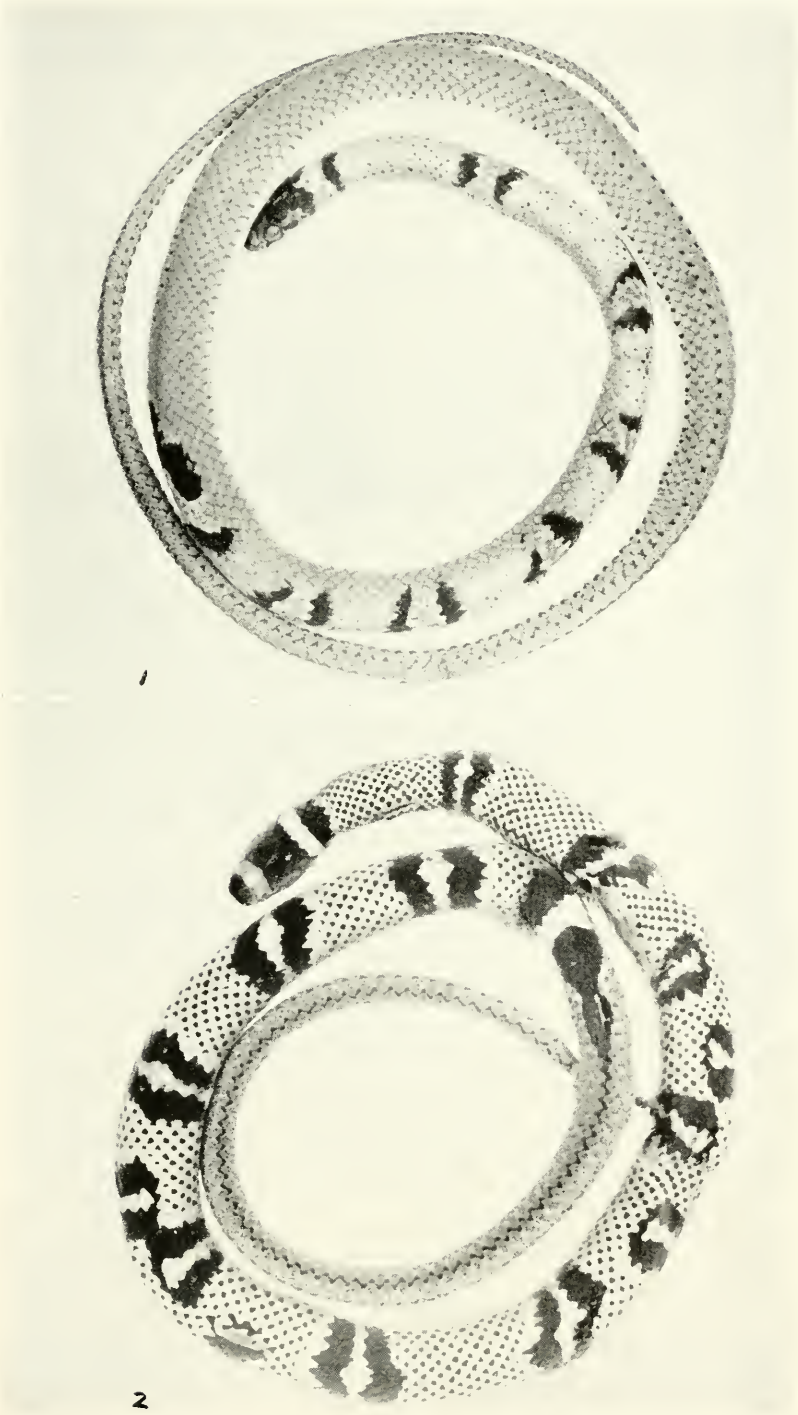

1
2

PLATE XXIV

Scaphiodontophis albonuchalis sp. nov.; a paratype, U. S. N. M. No. 6580, San Juan Bautista, Tabasco, México.

PLATE XXIV

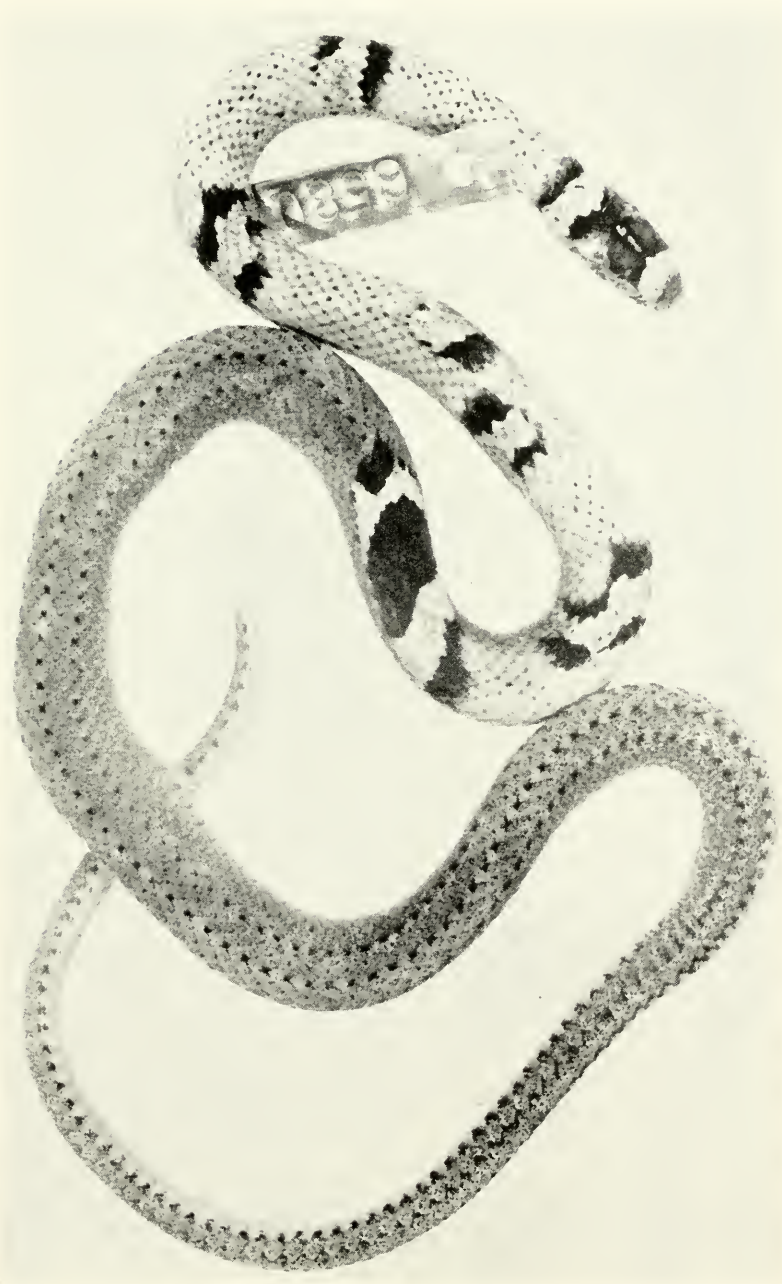
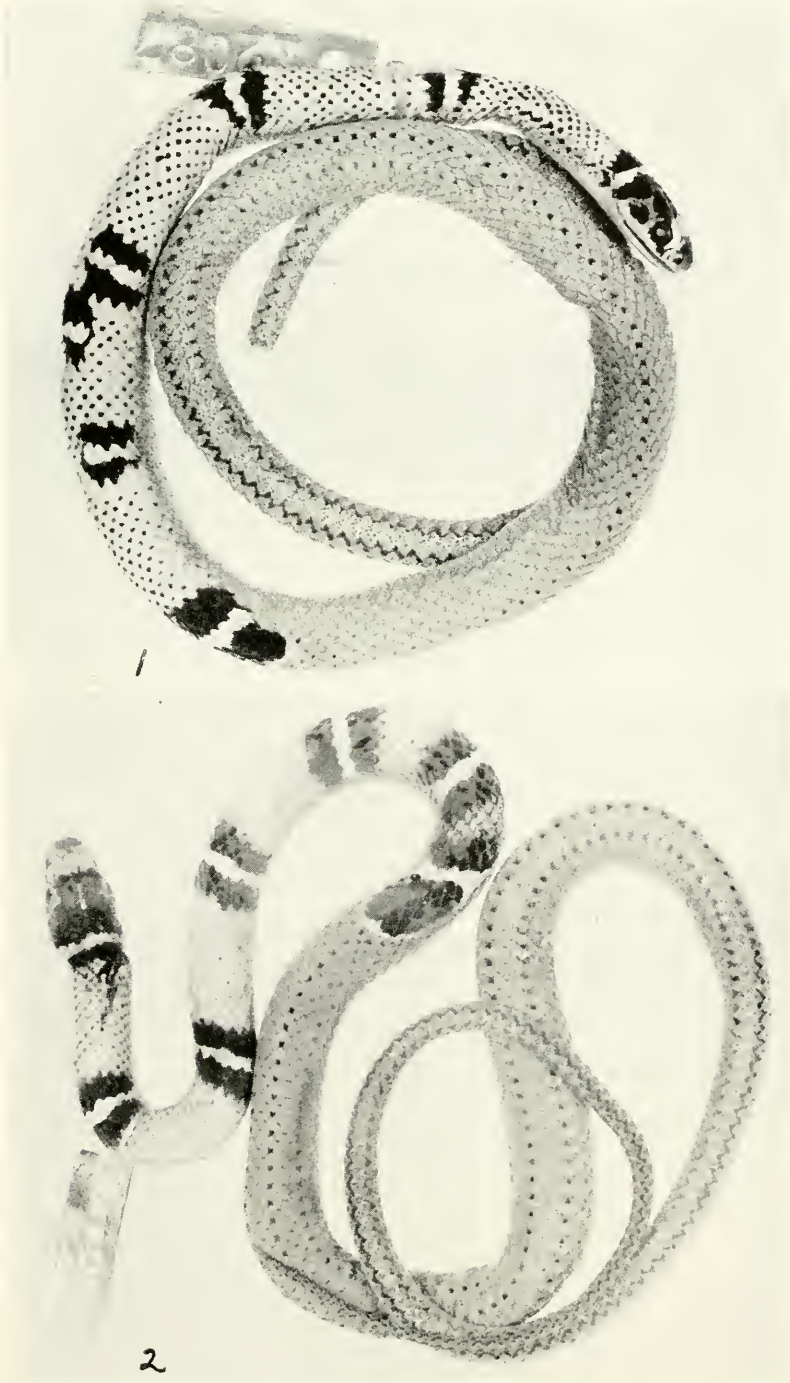


PLATE XXV

FIG. 1. *Scaphiodontophis albonuchalis* sp. nov.; a paratype, U. S. N. M. No. 12087, "Mexico."

FIG. 2. *Scaphiodontophis albonuchalis* sp. nov.; a paratype, U. S. N. M. No. 12693, Escuintla, Guatemala.

PLATE XXV



THE UNIVERSITY OF KANSAS
SCIENCE BULLETIN

VOL. XXIX, pt. II.] OCTOBER 15, 1943 [No. 7

Skin Shedding in the Salamander, *Amphiuma means*

By EDWARD H. TAYLOR,
Department of Zoölogy, University of Kansas

ABSTRACT: Two captive specimens of salamanders, one of *Amphiuma means* and one of *Amphiuma tridactylum* were observed while the former was shedding its skin. The *tridactylum* quite deliberately assisted the other animal in the removal of the skin, presumably for the purpose of eating the shed material.

TWO captive specimens, one of *Amphiuma means* and one of *Amphiuma tridactylum*, housed in a large aquarium at the University of Kansas were observed while one of the animals was shedding the skin.

My attention was attracted to the aquarium, occupied only by the two animals, by the *Amphiuma means*, an individual about 22 inches in length which was "standing on its tail" in the characteristic resting pose but with its jaws wide-stretched and the pharyngeal region somewhat dilated. Its behavior suggested an animal in distress, perhaps suffocating, and I at once released more air through the water. It repeated the jaw-stretching about every ten to fifteen seconds. On increasing illumination above the aquarium I noticed that the epidermis had broken about the jaws and was loosened on the top of the head. After approximately two minutes the "yawning" ceased, and the animal sank to the sand on the bottom and began roving about, rubbing its head against the sand bottom, the glass front, or the rough cement surface forming the back wall of the aquarium. Sometimes the side, sometimes the ventral surface was rubbed, and then turning laterally or up-side down the dorsal surface would be brought in contact with these surfaces. Sometimes it kept to the bottom and slowly revolved its body as it moved forward. In this manner the loosened skin was pushed or rolled back some five inches from the tip of the snout.

At this point the *tridactylus*, which had been lying quiescent at the other end of the aquarium some three and one-half feet distant, began moving forward an inch or two at a time, first to the right then to the left, up or down, sometimes with the head on the bottom, sometimes with the anterior half of the body reared a foot above the bottom. This behavior is almost identical to that ordinarily observed, about two minutes after raw beef is placed in the water at a point distant from the creatures, when it appears that they have first sensed the presence of the food and begin their search for it.

The shedding animal now raised itself from the bottom to the "standing" position, and, by a seemingly longitudinal contraction, increased the girth at a point in front of the skin roll which was seen to move back slowly as the body was moved back and forth at this point. This was repeated a number of times, and slowly, an inch or less at a time, the roll continued moving back.

By the time the roll had reached a point some ten inches back from the head the *tridactylum* had come up and began running its head back and forth on the posterior part of the body and tail of the shedding animal, which was in contact with the bottom, gently nipping at the surface as though trying to catch the epidermis with its teeth. This behavior was kept up incessantly while the other animal, the anterior three-fourths of the body reared above the bottom, kept pushing the ever-increasing roll back farther, by the method described.

When the roll was one or two inches from the base of the tail, further effort was apparently of no avail, and the shedding animal lowered the anterior part of its body to the bottom and became quiet.

Immediately the *tridactylum* traced forward on the tail and body until its snout came in contact with the roll, at which moment it made a quick grasp and caught the roll. It then began to tug and pull the quiescent animal about the water, first up, then down, never releasing its hold.

Apparently finding this of little avail it swam to the bottom and kept up the swimming movements, pinning the quiet animal to the bottom and at the same time twisting its head, first to one side, then to the other, then partially rotating the entire body in the same manner. This still proved unsuccessful. Suddenly it straightened and stiffened its body which then began revolving with remarkable rapidity for about five seconds. Its movement was so rapid that I could not count the revolutions, but estimate that they were more than six per second. The roll was thus twisted, as with a tourniquet,

constricting the body greatly, and finally breaking. As soon as it ceased revolving its body, it gulped twice, engulfing the skin roll.

After about ten seconds, during which time the *tridactylum* remained motionless, it resumed its movement along the tail of the other animal, nipping and breaking away the loosened bits of epidermis, finally stripping the terminal part from the tail, and engulfing this also.

From this behavior one suspects the presence of a substance entering and diffusing through the water at the time of shedding which is sensed by smell (or taste) and which is perhaps generic in character since it was recognized by a different species.

Whether such "assistance" in shedding is usual or significant I do not know. It was apparent that the shedding animal behaved as if it aquiesced in the process.

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VOL. XXIX, pt. II.] OCTOBER 15, 1943 [No. 8

Herpetological Novelties from Mexico

BY EDWARD H. TAYLOR,
Department of Zoölogy, University of Kansas

ABSTRACT: The following new forms of Mexican Amphibia are described: *Bolitoglossa cochranae* (PLETHODONTIDAE), Cerro San Felipe, Oaxaca, Oaxaca; *Rhyacosiredon leorae* (AMBYSTOMIDAE), Near Río Frío, México, México; *Bufo perplexus* (BUFONIDAE), Mexcala, Guerrero; *Bufo nayaritensis* (BUFONIDAE), Tepic, Nayarit; *Tomodactylus albolabris* (LEPTODACTYLIDAE), Agua del Obispo, Guerrero; *Syrrhophus nebulosus* (LEPTODACTYLIDAE), Tonalá, Chiapas; *Microhyla mazatlanensis* (MICROHYLIDAE), Mazatlán, Sinaloa.

THE following species are a part of the Edward H. Taylor-Hobart M. Smith collection (EHT-HMS), all being from México.

Bolitoglossa cochranae sp. nov.

Type. EHT-HMS No. 24594, Cerro San Felipe, Oaxaca, Oaxaca, México. Richard C. Taylor and Edward H. Taylor, collectors, 1940.

Paratypes. EHT-HMS Nos. 17726-17727, August, 1938, E. H. Taylor; EHT-HMS Nos. 24589-24593, 24595-24599, U. S. N. M. No. 19483, July, 1940, Taylor & Taylor; all topotypes.

Diagnosis. A rather small species apparently related to *Bolitoglossa altamontana*. It differs from that form in having shorter limbs, the adpressed limbs separated by two costal folds in the adults. Tail shorter, about 70 percent head-body length. (In *altamontana* the adpressed limbs touch and the tail is equal to from 90 percent to 100 percent of head-body length, depending on age.)

Fingers and toes partly webbed, only the tip of first finger and toe free from membrane; 13 costal grooves; fold under tongue very slight; teeth large, faintly bifid at tip; parasphenoid teeth in two rather narrow series converging anteriorly.

Description of the type. Head broader than body, flattened between orbits; snout short, somewhat rounded in profile; canthus

rostralis lacking; loreal region sloping, not concave; nostrils far forward, nearly terminal, the distance between them a little less than interorbital width; posterior parts of eyelids tucked under a diagonal fold; length of eye one-fifth more than its distance to the end of the snout; a sharply-defined longitudinal groove from near eye to the ends of the nuchal fold; nuchal fold strong, the groove arising from its lateral edge passes up and meets its fellow on the middorsal line; a vertical groove begins at the longitudinal groove, runs down back of the jaw angle, and can be traced a short distance across the throat. Posterior hyoid horn forms a strong ridge from nuchal groove to above arm, as far as the second costal fold; 13 costal grooves, counting one each in axilla and groin, although these latter are not or but dimly indicated; a slight trace of a median dorsal groove; 10 costal grooves can be traced across the belly; anal opening a longitudinal slit, the walls within the cloacal lips, plicate; limbs moderately developed, when adpressed they are separated by two costal grooves; fingers somewhat flattened, conical, the pads under the tips only moderately developed; the web involves the first phalanx of the digits although it is somewhat excised between them. First finger has only the tip extending beyond the membrane; the order of size of the fingers is 1, 2, 4, 3. The web on foot involves the first phalanx of toes; only part of the terminal joint is free on first toe. The order of size for toes is 1, 5, 2, 4, 3, or (3 = 4).

Skin of head and sides pitted strongly and minutely corrugated; skin of dorsum very smooth; the skin is slightly folded longitudinally between the costal grooves; belly and under surface of tail without pits. A small glandular spot behind insertion of femur.

Sublingual fold not distinct; maxillary-premaxillary tooth series, 29-29; teeth heavy, slightly bifid at tip; mandibular teeth, 29-28; vomerine teeth 13-14 extending beyond outer level of choanae; the two series are narrowly separated medially, and are separated from the parasphenoid teeth by a distance equal to half the distance between the choanae; parasphenoid teeth in two narrow series diverging posteriorly, separated anteriorly.

Color. Body somewhat brownish with a lavender grayish wash. Numerous, small, black spots on dorsal and lateral surfaces of body and tail and limbs; belly dark lavender with a few light flecks along sides; chin and throat lighter with small light flecks.

Measurements of type and paratypes in mm. Nos. 24592, 24594, 17727; sex, ♂, ♀, ♀; snout to vent, 39, 53.5, 57; tail, 27, 34.5, 43; snout to arm, 12, 14, 15.5; axilla to groin, 21, 30.5, 32.4; width

of head, 6.8, 8, 8.8; head, to gular fold, 9, 10.8, 11; arm, 9.8, 11, 12; leg, 11, 14, 14.4.

Variation. Most of the specimens agree with the type in color and markings. However, No. 25590 is deep blackish lavender and the black spots can be discerned only when the specimen is submerged; No. 17725 is light brown with two lighter brown areas on occiput (visible in some of the other specimens). The hedonic gland on the chin is present in the males but is not especially conspicuous. The cloacal walls of the males are strongly papillate. A female specimen, No. 17727 contains 16 large ovarian eggs, 8 in each ovary. Since the oviduct is greatly distended it is presumed that the eggs are ready to be laid.

Remarks. All the specimens found were taken in tiny piles of leaves on the ground. They were found in a single locality at an elevation of about 8,800 feet. They were obtained on two different visits to the mountain. The species is named for Dr. Doris Cochran of the Department of Herpetology of the United States National Museum.

Rhyacosiredon leorae sp. nov.

(Plate XXVI, fig. 3)

Type. EHT-HMS No. 22560. Adult male, collected in a mountain stream near Río Frío, México, either in the state of Puebla or México (Balsas River drainage system), by Dyfrig McH. Forbes, 1939.

Paratypes. EHT-HMS No. 22561; U. S. National Museum No. 116629-116632, adults and larvae. All topotypes, same collector as type.

Diagnosis. A large species, maximum known size, 98 mm. snout to vent; more closely related to *Rhyacosiredon altamirani* than to *R. rivularis.* It differs from the former in having a longer body with relatively small limbs. The hind toes fail to reach the elbow by a distance equal to the width of one or two costal folds. The digits are broader, the tail more elevated at its base. The head is proportionally shorter and broader. Greenish olive above and dorsolaterally, thickly studded with distinct brown spots, the tail mottled indistinctly with darker and lighter; cream below.

Description of the type. Width of head (21 mm.) less than the length (24 mm.); interorbital distance equal to length of snout and likewise equal to the distance between the nostrils, which are terminal; total length of eye (4 mm.) equal to its distance to the nostril; mouth very narrow; the labial fold visible on edge of lower jaw, but

partly overhung by a flap from upper lip. The neck is strongly constricted, its width (12 mm.); a distinct fold on the neck, back 19 mm. from tip of snout.

Arm strong, brought forward it reaches to slightly beyond nostril; order of length in fingers, 1, 4, 2, 3; of toes, 1, 5, 2, 3, 4; a skin fold on outer side of foot extending along the fifth toe, and a similar one on the hand bordering the fourth finger; a pair of tubercles on back part of palm and sole. Tail distinctly longer than head and body (in adults); a somewhat thickened dorsal fin and a trace of a ventral fin on the strongly compressed tail; elevation at base 12 mm. while the greatest depth of body is 15 mm.

Maxillary-premaxillary tooth series about 25-27 (counting certain spaces for absent teeth); teeth unequal in size, slightly bifid at tips; vomero-palatine series broken, together forming an arch which is broken medially; the number is 5 + 10 on each side, the teeth extending much anterior to the elongate choanae. Tongue very small, strongly lamellate, spongy, the tissue strongly pitted between lamellae.

Eleven distinct costal grooves, 10 costal folds (the axillary very indistinct but present in a paratype, making 12 grooves and 11 folds). Cloacal region strongly inflated, the inner edges strongly papillate.

Aside from very numerous miscroscopic pits on the head the remnants of the neuromast system is evidenced by larger pits distributed as follows: a double row begins above the nostril and continues to above eye; low on lores there are several pits irregularly arranged; one row runs below eye; between eye and jaw, and to a lesser extent behind eye are several pits; a row runs along the lower jaw. A dorsolateral series can be discerned, but only one or two pits of the lateral and ventrolateral series (scarcely more distinct in larvae) are evident.

Color. Olive to gray olive on top and sides of head and on back; the tail is very indefinitely mottled with grayish and tan cream, scarcely differentiated; lower sides and ventral regions dirty cream, there being some scattered pigmentation visible under a lens; limbs gray olive above. Dorsal and dorsolateral surfaces of head, body and limbs strongly spotted with dark brown.

Measurements in mm. (of the adults of the type series). Nos. 22560, type, 116629, 22561; sex, ♂, ♀, ♀, respectively; snout to vent, 81, 93, 98; tail length, 88, 104, 109; width of head, 21, 22.5, 23; length of head, 24, 26, 26; axilla to groin, 36, 46, 47; arm 28, 30, 29; leg, 30.5, 32, 33.

Variation. One of the specimens a large female has the depth of the tail less than in the other two specimens approaching in this character somewhat the condition obtaining in *altamirani.*

The specimens have the inside of the buccal cavity covered with well-defined papillae. The arrangement of the larval teeth is similar to that of the adults.

Remarks. It is presumed that the form is confined the upper reaches of the tributaries of the Balsas river. It will probably be found to be common in small streams originating in the glaciers and snows of Popocatepetl and Iztaccihuatl.

Bufo perplexus sp. nov.

(Plate XXVII, figs. 1, 2)

Type. No. 707 E. H. Taylor-H. M. Smith Collection; collected near the edge of the Balsas river, near the town of Mexcala, Guerrero, México, June 24, 1932, by E. H. Taylor and H. M. Smith.

Paratypes. EHT-HMS collection, Nos. 18213-18216; 18221-18224. About 10 km. northeast of Cuernavaca, Morelos; 682-683, 6209-6234, 18217-18220, at km. 133, near Huajintlán, Mor.; 6267-6271, 6273-6274, El Naranjo, Guerrero; 6235-6265, 18441, Tonolapam, Guerrero; 684-706, 708, 709, 708A, 6275 (Km. 252), 6266 (km. 240), 6276, vicinity of Mexcala, Guerrero; 25419-15422, vivinity of Chilpancingo, Guerrero; 813-818, 820-828, Tonalá, Chiapas. U. S. National Museum Nos. 116564 Puente de Ixtla, Morelos; 116565-116568, Tehuantepec, Oaxaca.

Diagnosis. A medium-sized toad, having a known maximum size of 66 mm. Apparently related to *Bufo marmoreus,* but with the cranial crests less distinct, the interorbital and postorbital crests forming an angle rather than a continuous curve, the supratympanic crest smaller, reduced to a mere boss on the postorbital crest; parotoid gland much closer to the orbit, being separated only by a distance equal to the thickness of the crest. In adults, the females lack the wide diagonal lateral stripe of the female *marmoreus* and the males do not have the coloration, or the concentration of the rough dorsal tubercles to a broad band on the back, as obtains in the males of *marmoreus.*

Description of the type. Adult female. Head moderately thick, the frontal region tending to curve down somewhat; snout sharply truncate, the nostrils near the most anterior point, which overhangs the mouth slightly; length of eye (7.5 mm.) longer than the snout (6.1 mm.); tympanum a little higher than wide (4.5 mm. × 4 mm.), its greatest diameter a little more than half the diameter of the eye

(on right side tympanum abnormally subcircular); parotoid gland somewhat rounded oval, its greatest length 7.2 mm., in contact with the postorbital crest, and separated from the orbit by the thickness of the crest. Canthal crest lacking, but the region is elevated a little; interorbital crest low, as is the postorbital, the two forming an obtuse angle rather than a curve; the pretympanic ridge indistinct but elevating the anterior margin of the tympanum; parietal crest indicated by a slight boss or tiny ridge; preorbital crest not or very indistinctly indicated; jaw with a slightly elevated ridge below the eye; interorbital width equal to an eyelid; area between the interorbital crests and the snout smooth, flat, with a slight depression continuing between the nostrils.

Tongue elongate oval, not emarginate behind; choanae large, transverse; palatines with odontoid rugosities. (Males with vocal sacs.)

Arms and legs short; first and second fingers subequal in length; all fingers lacking distal subarticular tubercles; a very large median palmar tubercle; a small inner tubercle but no outer tubercle evident; toes one third (or somewhat more) webbed, the fringe continued to near the tips of the digits; an elevated, slightly compressed, inner metatarsal tubercle; a small outer metatarsal tubercle; tarsal fold faintly indicated, bearing a few tubercles.

Skin of back with numerous pustules each bearing fine granules; parotoids granular; sides pustular while the ventral surface is entirely covered with uniform flat granules. (In males, skin much rougher and the granules often with horny tips.)

Color. Generally brown-olive above, with markings or reticulations of olive or fawn indicated; a V-shaped dark spot on the interorbital region the sides of which extend upon the upper eyelids; anterior to this the snout and the anterior parts of the eyelids faun or grayish; sides of the snout, lip and tympanic region with brown spots; a median light stripe extends from the occiput to vent; arms and legs variously barred with brown, the median stripe most distinct; tips of the digits with some horn color; entire ventral surface creamy white, with some slight pigmentation on chin and breast.

Measurements in millimeters of type. Snout to vent, 61; width of head, 25; length of head, 20; depth of head at tympanum, 10.2; depth of head in front of eye, 9.1; arm, 38; leg, 73.5; tibia, 23; foot, 35.2.

Variation. The large series from numerous localities shows a remarkable constancy in the essential specific characters. The color

is variable, and the specimens collected at night seem to show the color pattern better than those taken in daytime. Most of the daytime specimens were taken from under rocks, or buried in the earth. In these some appear very dark and there is little or no pattern visible unless the specimens are placed under water, in which case the pattern can frequently be distinguished.

Males show the typical nuptial asperities on the first two fingers and the skin is rougher than that of the females. Their pattern often shows two larger paired spots on the back which are contiguous with other spots; and they are smaller than the females.

Remarks. The largest aggregation of these toads was encountered at a small rivulet that flows to the south of Tonolapam, Guerrero. While camped here I collected 25 specimens within a radius of 50 feet of my camp. One might have collected hundreds in the general locality without trouble. The rivulet was teeming with very small black tadpoles, and I presumed that the breeding had taken place some time before. None were calling, and none were in the water at this time.

The species when seen in series is very easily distinguished from *Bufo marmoreus.* (See pl. XXVI, figs. 1b, 2.) However, I suspect it will be found that specimens are already in some museum collections catalogued under the name of *marmoreus.*

The known range includes the Balsas basin of northern Guerrero, southern Morelos, southern Oaxaca and the Pacific lowlands of Chiapas. It may be present in southern Guerrero, but it has not yet been found there. It is replaced, for the most part by *Bufo marmoreus,* yet *Bufo gemmifer, horribilis* and *coccifer* have also been taken.

Bufo nayaritensis sp. nov.

(Plate XXVI, figs. 1, 1a)

Type. No. 397, E. H. Taylor-H. M. Smith Collection; collected at Tepic, Nayarit, July 28, 1934, by Edward H. Taylor.

Paratypes. EHT-HMS No. 380-396; 398-426, 426A. (Nos. 401-404 skeletons) Topotypes, same data as type.

Diagnosis. Related to *Bufo mazatlanensis,* but differing in having a relatively longer first finger, nearly a third longer than the second; a larger parotoid, which equals or is greater than the length of the eye; a narrower interorbital region; the interorbital crests are nearly parallel for most of their length, the metatarsal tubercles are a little larger and the feet are relatively larger; the tibiotarsal articulation reaches to the tympanum.

Description of the type. Head bearing rather low crests, those on the canthi lowest, running nearly parallel anteriorly; preorbital, supraorbital and postorbital crests of about equal height, the latter having a short pretympanic and supratympanic branch; a short, low occipital crest; an infraorbital crest from below the tympanum to the anterior level of the orbit; tympanum moderately large, subcircular, its diameter (5.2 mm.) equal to a little more than half of the eye (8.5 mm.) and slightly more than half the distance between the pre- and postorbital crests (9.8 mm.); the width of an eyelid is 5.1 mm. as compared with the distance measured from the level of the interorbital crests of 7 mm.; length of snout 8.5 mm.; greatest length of the parotoid 10 mm., its width 6.2 mm.; the distance between the parotoid and the postorbital crest, 3.1 mm.; nostril nearer eye than edge of lip; elevation of snout at nostrils 6.4 mm.; greatest elevation of head (to top of crest) 11.1 mm.

Tongue small, oval, not notched, free for about one-third of its length; opening of the vocal sac sinistral; palatine with a few rugosities.

Arm short; first finger thick, more than a fourth longer than the second; a fourth or fifth shorter than the third; the outer subarticular tubercle divided on the third finger, while on the others they are very slightly bilobed; outer palmar tubercles large, oval; inner covered with nuptial excrescences of black-brown horn; similar excrescences on the dorsal surface of the first finger, most of the surface of second and the inner side of the third; the palm and sides of fingers with numerous conical tubercles; toes except third, webbed for about half their length, the webs continued as ample, serrate fringes to the tips. Inner metatarsal tubercle elongate, sharply conical anteriorly, its length a little less than that of first toe; outer tubercle small; the subarticular tubercle on the fifth toe bifid; no tarsal fold but the tubercles occupying its position are a little larger than others; tibiotarsal articulation to the tympanum; when legs are folded at right angles the heels are separated by about 3 mm.; sole with numerous tubercles.

Skin strongly pustular; an irregular row of larger pustules on either side of the middle of the back; tubercles beset with numerous dark brown horny spinules; no noticeable lateral fold bearing larger tubercles; venter uniformly granular.

Color. Above dirty brown, somewhat variegated with a very dim suggestion of a lighter median streak when examined under water; below yellowish; the sides bearing yellow or cream tubercles among

the darker ones; the underside of the foot and hand darker than the venter; upper lip yellow, bearing a few dark-brown spinules; crests, deep brown.

Measurements (in mm.) of type. Snout to vent, 70; width of head at tympanum, 26; length of head, 21; greatest depth including crest, 11.2; arm, 36; hand from back of palmar tubercle to the tip of third finger, 15.2; leg, 84; tibia, 27; foot, 38; from posterior edge of metatarsal tubercle to end of fourth toe, 24.

Variation. The large series shows but little variation. The size of the parotoid gland is constant, some slightly larger, some perceptibly smaller. In practically all cases the length exceeds the greatest distance between the pre- and postorbital crests. The vocal slits are sinistral and dextral in the proportion of 3 to 5; none were found having slits on both sides. The maximum size of the males is 73 mm; seventeen of the lot are above 65 mm., three above 70 mm.

Tomodactylus albolabris sp. nov.

Type. EHT-HMS No. 29568, collected at Agua del Obispo Guerrero (km. 351), Aug. 24, 1941, by Edward H. Taylor.

Paratypes. EHT-HMS Nos. 6944, 6945, 29567, 29569, 29570, Agua del Obispo; 6939, 9 km. south of Mazatlán, Guerrero.

Diagnosis. A small species, maximum size 23.8 mm.; disks of two outer fingers distinctly widened, truncate; posterior part of the ventral disk granular; back and sides more or less pustular; tibiotarsal articulation to eye; tympanum rather indistinct, its greatest diameter less than half of the eye; lip light, usually silvery to white; a red or red orange spot on the anterior part of the thigh, sometimes extending onto the groin, and also some reddish or orange spotting on the posterior face of thigh.

Description of the type. Snout pointed the tip slightly rounded, and lacking a distinct canthus rostralis; upper loreal region nearly vertical, the lower sloping, somewhat concave; diameter of the eye (2.6 mm.) equal to the distance between eye and a point a little beyond the nostril; interorbital width (2.9 mm.) much greater than the width of a single eyelid (1.75 mm.); tympanum partly concealed by skin, higher than wide; its greatest diameter (1.2 mm.) less than half the length of the eye, while its narrowest diameter is about equal to its distance from the eye.

A large vocal sac, the internal slits on the floor of the mouth large, and the skin distended externally; no vomerine teeth; choanae large, lateral (deformed on one side); tongue pear-shaped widened

posteriorly, without trace of notch or emargination behind, free behind for half its length.

Arms slender, the two outer fingers with distinct truncate disks wider than the remainder of the digits, while the tips of the inner fingers are not noticeably wider than the digit; first finger equal to or a little shorter than second; median palmar tubercle large, that at the base of the first finger less than a fourth as large, while the distinct outer tubercle is still smaller; subarticular tubercles large, especially those under first two fingers; intercalary and supernumerary tubercles present, the latter numbering five; numerous small granules on the sole and between the bases of the digits. A single small tubercle on the wrist.

Legs short, the tibiotarsal articulation when brought forward reaches to the back part of the eye, and when folded at right angles the heels touch or are minutely separated; tips of toes truncate, not or but slightly widened at the tip; fifth toe small the length of its free part contained in the free part of the fourth, three and a third times; subarticular tubercles of inner toes larger than those on outer; intercalary and supernumerary tubercles present, but rather small; sole covered with very small, distinct tubercles or granules; inner metatarsal tubercle large, but smaller than the subarticular tubercle of first toe; no tarsal fold.

Skin of the head smooth while that of the back is also smooth although the pustules can be easily discerned; a small raised lumbo-inguinal gland present that fails to reach to the level of the thighs when legs are folded at right angles to the body; sides with smooth-surfaced pustules; posterior part of the ventral disk granular; skin of the throat and breast smooth; a large but not especially distinct parotoid gland above the arm extending nearly to the tympanum.

Color. General color on dorsal surface, olive to olive brown in life, with some scarcely discernible darker areas not forming a pattern; a dark brown stripe from tip of the snout to the eye, below which the lip is silvery or whitish; a small black spot on the tympanic region, and two or three small black spots low on the sides; a larger black spot covers most of the lumbo-inguinal gland; venter generally creamy yellow with a few indistinct darker spots which are diffuse and indistinct; upper surface of limbs with small black spots instead of bands; a large red spot on the anterior face of the femur which extends on the groin somewhat; some reddish spots on the posterior part of femur. Some scattered dark pigment on the chin.

Measurements in mm. Type; ♂. Snout to vent, 23,8; width of head, 9.5; length of head, 8.5; arm, 13.3; leg, 29.5; tibia, 10; foot, 14.

Variation. The type series displays but very little significant variation. The extent of the granulation on the ventral disk may be a little more than occurs in the type. The spots may be orange, or red-orange. This color fades and in the preserved specimens today the color is yellowish-white. Sometimes the tympanum is very indistinct, rarely more distinct than type. One darker specimen shows some minute light maculations on the dorsal surface.

Remarks. The species occurs in the pine country about Agua del Obispo. Their presence was discovered by tracing the call, which is a peculiar whistle. All were taken from trees. From the number of calls heard it would appear that the species is not rare. However, most of the calls came from high trees. Even when in reasonably low trees that could be climbed, the specimen was usually perched at the tip of a branch where the collector did not dare to venture, or more frequently where it was out of the sight of the collector. It required more than than the usual amount of effort to obtain this small series.

Syrrhophus nebulosus sp. nov.

(Plate XXVII, figs. 3-5)

Type. EHT-HMS No. 3774, collected near Tonolá, Chiapas, Aug. 27, 1935, by Hobart M. Smith and Edward H. Taylor.

Paratypes. EHT-HMS Nos. 3759-3766, 3772, 3773, 3775, near Tonalá, Chiapas, Aug. 27-31, 1935; Nos. 3767, 3768, 3776, Tuxtla Guterriez, Chiapas, Sept. 4, 1935, Nos. 3769, 3770, 3777-3779, Tapachula, Chiapas, Aug. 24, 1935;? No. 3771 near Rodriguez Clara, Veracruz. Sept. 7, 1935.

Diagnosis. Related to *pipilans* but smaller, with a somewhat narrower snout, but like it lacking the small outer palmar tubercle. The tympanum is more than one-third of the eye, and scarcely larger in males than females. Venter absolutely smooth; parotoid above arm of rather large area; inguinal gland small, indistinct; known maximum size, 25 mm. Width of upper eyelid contained in the interorbital distance one and one-half times.

Description of type. Head pointed, oval, the canthus lacking; lores sloping, not concave, perhaps slightly inflated in front of eye; distance of the nostril from tip of snout is contained twice in its distance from eye; length of eye (3.05 mm.) a little longer than the distance to the nostril (2.85 mm.) greater than width of a single eyelid (2.4 mm.); tympanum subcircular, a little higher than wide, its

greatest diameter (1.3 mm.) contained in eye length 2.42 times. A large flat parotoid gland behind and partly above the tympanum; lumbo-inguinal gland greatly reduced or absent.

Tongue moderately elongate, not notched behind, free for one-half to two-thirds of its length. Choanae large, completely concealed by the shelf from the maxillaries, when seen directly from below; no trace of vomerine teeth.

Arm slender, fingers long, very slightly widened at the tips which in normal state lack transverse grooves (indicated when disk is slightly dehydrated); second finger markedly longer than first; subarticular tubercles large; five supernumerary tubercles on palm; a small palmar tubercle at base of first finger; less than half as large as the very large (median) palmar tubercle; no outer tubercle; a few minute granulations on palm; two or three small tubercles on wrist; no axillary gland. Leg rather short, the tibiotarsal articulation reaches to middle of the eye; tips of toes slightly dilated without grooves across tip (unless dehydrated). Two metatarsal tubercles, the inner more than double the size of the outer; subarticular tubercles large, elevated, conical; numerous small supernumerary tubercles, the skin with numerous granules; web remnant between toes scarcely discernible; fifth toe small, its free part (2.45 mm.) contained in free part of the fourth (7.15 mm. measured on inner side) nearly three times (2.9); no trace of a tarsal fold.

Skin on back smooth, with very indistinct, flattened pustules or tubercles; sides more distinctly areolate; entire venter absolutely smooth; a well-defined ventral disk; posteroventral surface of thigh partly granular; when limbs are folded at right angles to body the heels overlap about 1 mm.

Color. Above light lavender brown, forming an indefinite nebulous pattern with a moderately distinct darker brownish stripe from tip of snout along the lores to eye, then behind eye to near insertion of arm; side light faun; venter creamy white, the chin with a minute peppering of black pigment, the abdomen immaculate, save on edges; legs light brown with a suggestion of lighter areas.

Measurements of the type in mm. Snout to vent, 24; snout to foreleg, 10; width of head, 8; length of head, 9.5; arm, 16; leg, 38.

Variation. The paratype series is from several localities. The two largest females measure 25 mm., the largest male about 21 mm. Vocal sacs are present in males, the slits on the floor of the mouth elongate. Folds of skin are evident on the underside of the chin. In some specimens the choanae are not entirely concealed. A few

of the specimens have the brown color inclosing lighter spots, and one is almost uniform light brown.

The premaxillary teeth, as in all members of the genus, are prominent and drop below the general level of the maxillary teeth. These are often visible below the edge of the lip.

Remarks. Occurring in their same general region is another small black and red species still undescribed. As remarked, the relationship of *Syrrhophus nebulosus* is apparently closest to *S. pipilans.* Future collections may show that the relationship might better be shown by a trinomial. However, the material at hand does not show intergradation. It is significant that the four species on the Pacific side lack the outer palmar tubercle, while those on the gulf side usually, if not always, have it present.

Microhyla mazatlanensis sp. nov.

Microhyla olivacea Taylor (*non* Hallowell), Univ. Kansas Sci. Bull., Vol. 24, No. 20, 1936 (Feb. 15, 1938), p. 516.

Type. E. H. Taylor-H. M. Smith Collection, No. 1236. Collected two miles east of Mazatlán, Sinaloa, July 20, 1934, by E. H. Taylor.

Paratypes. EHT-HMS No. 1237-1238 Topotypes, same data as type.

Diagnosis. Toes without webs, the outer metatarsal tubercle absent. Related to *Microhyla olivacea* but distinctly smaller in size, the head a little narrower, the snout projecting more, a little more flattened above and rounding at the tip; eye smaller proportionally; choanae smaller, largely concealed by the shelf from the maxilla when seen from below; toes and fingers more rounded without a lateral ridge. An indistinct black stripe behind eye to some distance on side. Brown above.

Description of the type. Body moderately stout, the head somewhat triangular; snout pointed, somewhat rounded, rather than truncate, extending beyond the tip of the jaw a distance equal to about one-half the length of the snout; length of eye (2.3 mm.) equal to .8 of the snout length (2.8 mm.); eye a little longer than its distance from the nostril; width of an eyelid 2.5 times in the interorbital distance. A slight diagonal groove from the corner of the eye to the insertion of the arm, which borders a thickened area which is in the nature of a parotoid (also in other species). There is no trace of the tympanum; a transverse area between the orbits is somewhat depressed; no evidence of the transverse occipital fold; nostrils small, lateral, back a slight distance from the tip of the

snout; front of the lower jaw with a small double notch, the median part not as elevated as the sides.

Choanae large; when seen directly from below they are more than half concealed by the prominent backward projecting shelf from the premaxillaries; no vomerine teeth; a palatal ridge between the posterior part of the orbits; behind this at a distance of .8 mm. is a second less prominent ridge behind which the buccal membrane is arranged in about 19 longitudinal folds which extend to the esophagus; openings of the eustachian tubes about one-third the area of a choana; tongue of type injured (of a paratype the tongue is much longer than wide, broadly rounded at each end, not notched or emarginate, and free for about a third of its length).

Arm rather short; hand short the three large palmar tubercles, moderately elevated, the median largest and contiguous or partially confluent with the other two; subarticular tubercles moderately elevated; tips of the digits thickened, but not widened, of the same width as the remainder of the digits; first finger much shorter than the second, which in turn is shorter than the fourth.

Legs short, the tibiotarsal articulation not reaching as far as the arm insertion, and only slightly beyond the elbow of the adpressed arm; when the limbs are folded at right angles the heels overlap a little; inner metatarsal tubercle very small (about one-third the length of the first toe); no trace of an outer tubercle; no tarsal fold; tips of the toes thickened, equally as wide as the digit; foot relatively narrow.

Skin smooth above, below, and on sides (female); anal opening followed by a deep triangular groove; femora not involved in the body skin for more than half their length.

Color. Above nearly uniform brown with some scattered black spots tending to form a pattern medially; a broken black line begins behind the eye and continues to some distance on the side; trace of an inguinal spot, which together with a single bar or spot on the femur, the tibia, and foot, form a continuous line when the limb is folded. Venter cream, with a very slight peppering of pigment on the chin; sides slightly mottled with lighter and darked; underside of the feet purplish brown, and the hands similarly colored, but to a lesser extent.

Measurements of type and paratypes in mm. Nos. 1236, 1237, 1238; sex, ♀, ♂, ♀; snout to vent, 22.2, 23.3; 24.8; width of head, 6, 6, 6.6; length of head, 6.5, 6.3, 6.5; arm, 9.8, 10.2, 11.2; leg, 28, 27.5, 31; tibia, 9.5, 9.2, 11; foot, 13, 14, 16.

Variation. The male has a well-defined vocal sac which is colored black and is visible as a blackish spot on the underside of the chin. The dorsal surface is beset with tiny, pearly-tipped tubercles, some of which are present on the dorsal surface of the arms and legs. Along the edges of the fingers and toes there is a row of sharply pointed tubercles with a few similar excrescences on the dorsal surface of the fingers and toes. A similar series of spines on the lower jaw. In the single male, the premaxillary shelf is somewhat less developed and not quite half of the choanae is concealed.

Remarks. These small specimens were obtained from a pile of rocks near a small temporary rain pool. In the same pile of stones I obtained the type of *Bufo mazatlanensis.*

These specimens were originally associated with *Microhyla olivacea,* although the differences were recognized at that time. (Taylor *loc. cit.*) Since then I have examined large series of this genus from México and have a better idea of the amount of variation that may be expected. This has caused me to regard this lowland form as distinct from *M. olivacea.*

The species differs from *Microhyla elegans,* in lacking the heavy pigmentation on the ventral surfaces, and the broad lateral stripe which begins on the tip of the snout. *Elegans* has well-defined lateral ridges or fringes on the sides of most of the digits, and the tips are flattened and somewhat widened. The inguinal spot is strongly defined.

Microhyla usta has been reported from Presidio in the southern part of Sinaloa and may also occur in this locality. This may be separated easily by the fact that *usta* has a very large inner metatarsal tubercle, and also a strongly developed outer one, while the described form has a small inner and no outer.

PLATE XXVI

FIG. 1. *Bufo nayaritensis,* from type, EHT-HMS No. 397, Tepic, Nayarit, México. x 1.

FIG. 1a. Side view of head of same. x 1.

FIG. 1b. Side view of the head of *Bufo marmoreus.* EHT-HMS No. 770, near Cinco Minas, Jalisco. x 1.

FIG. 2. *Bufo marmoreus.* EHT-HMS No. 770, near Cinco Minas, Jalisco. x 1.

FIG. 3. *Rhyacosiredon leorae,* from type. EHT-HMS No. 22560, near Río Frío, México, México. x 1.

PLATE XXVI

1b

1a

1

3

2

PLATE XXVII

FIG. 1. *Bufo perplexus,* paratype male EHT-HMS No. 6258, near Tonolapam, Guerrero.

FIG. 2. *Bufo perplexus,* paratype female, EHT-HMS No. 6269, near El Naranjo, Guerrero.

FIG. 3. *Syrrhophus nebulosus,* paratype, EHT-HMS No. 3772, near Tonolá, Chiapas.

FIG. 4. *Syrrhophus nebulosus,* type, EHT-HMS No. 3774; near Tonolá Chiapas, about x 1.

FIG. 5. *Syrrhophus nebulosus,* paratype, EHT-HMS No. 3773, near Tonolá, Chiapas.

1
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4
5

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The Mollusca of the Wakarusa River Valley

DOROTHEA S. FRANZEN and A. BYRON LEONARD,
The Department of Zoölogy, The University of Kansas

ABSTRACT: The recent mollusca of the Wakarusa river, a small tributary of the Kansas river, are reported and their ecology discussed. Sixteen species of freshwater mussels, and thirty-one species and subspecies of gastropods are listed from a series of eleven described collecting stations.

INTRODUCTION

PURPOSES OF THE STUDY

MANY faunal studies are based on political units, such as counties or states, a practice not without a certain element of practicability, but since few animals, and so far as known, no mollusks seem aware of these boundaries, it seems more in keeping with the nature of the problems at hand, to consider the distribution of animals from the standpoint of some natural physical unit, such as a single drainage system. The Wakarusa river and its valley seemed admirably suited for a study of faunal distribution, and had the advantages of being conveniently located, not too extensive for the limitations imposed by time and expense, and yet variable enough from source to mouth to present for study an interesting series of habitat variations. Thus, habitat types along the stream and its valley include: (1) deep, rather swift waters over firm mud or rock bottom; (2) deep, semistagnant waters over mucky silt; (3) shoals of sand, gravel, or shingle; (4) well-drained, wooded slopes; (5) moist floodplains with relatively heavy growth of vegetation; and (6) marshes and ponds.

Furthermore, mere lists of species from an area, while giving some idea of distribution, are of doubtful scientific value. If any progress is to be made toward a knowledge of factors controlling distribution,

or if any light is to be thrown on the problems of the factors governing speciation, then animals must be studied in relation to their environments. This is an almost untouched field, especially with regard to the mollusks.

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THE WAKARUSA RIVER AND ITS VALLEY

The Wakarusa river is a relatively small stream that rises from a series of small brooks along the eastern border of Wabaunsee county. It flows eastward and slightly northward to empty into the Kansas river at the village of Eudora, a distance from source to mouth of about sixty miles in a direct line. The actual length of the stream itself is naturally much greater. The brooks from which the Wakarusa originates drain the eastern slopes of the Flint Hills uplift, where they have eroded the alternating shales and limestones of the Admire group of formations, of presumed Permian age. The Wakarusa, a competent stream in its upper reaches, has, in western Shawnee county, exposed another series of shales and limestone, the members of the Wabaunsee group, of Pennsylvanian age. As the stream crosses Shawnee county, it incises the members of the Shawnee group of geological formations, likewise of Pennsylvanian age, and near the village of Wakarusa the stream emerges upon a rather broad terrace, which is underlain by the members of the Douglas group. Across most of Douglas county, the Wakarusa river is a sluggish stream, meandering widely in its course, and flanked by broad, level terraces. The only rock exposed downstream is the massive sandstone of the Stranger group, which is visible along the south bank of the stream above Eudora.

The drainage basin of the Wakarusa consists of a series of valleys cut into the plateau which composes southern Shawnee and northern Osage county, the rolling hills of western Douglas county, and the almost unrelieved terrace flats of eastern Douglas county. Since the underlying rocks have not been deformed by faulting or folding, the topography of the western portion of the Wakarusa valley is the result of erosion only, except for the modifications due to deposits of

glacial origin. The basin drained by the stream is relatively narrow, north and south, and very rugged over the western half or more, as might be expected from the nature of the underlying rocks. In spite of the relative narrowness of the drainage basin as a whole, the terraced valley flanking the stream is unusually broad, even far upstream. The width of the terrace slopes suggests that at some former time the Wakarusa has been a much more important drainage system than at present, in fact, it has been conjectured that it once acted as a spillway for the Kansas river when that stream was obstructed by the Kansan ice sheet during Pleistocene times. The extensive deposits of glacial till or outwash along the northern slopes of the valley add credence to this suggestion. While the terrace plain is broad, and especially so downstream, the actual floodplain is extremely narrow. This is due, in part at least, to canals and other devices which have tended toward straightening the stream.

Downstream the Wakarusa is sluggish and meandering, turbid, and heavily silted. While the turbidity in the entire stream is conspicuous, this feature is especially notable near the mouth, above which for several miles tenacious black silt fills the bed to a depth of several feet.

The total range of elevation of the drainage basin is about four hundred feet. The highest point is found in eastern Wabaunsee county, where the elevation is about 1,200 feet; at its mouth, the valley is about 800 feet above sea level.

The soils of the area under consideration may be divided into three principal groups—glacial, residual and alluvial. The glacial soils are characterized by their reddish-brown color, gently rounded topography, the absence of fragments of the Pennsylvanian rocks and shales, and the presence of quartzite and granite boulders, sharp quartzite sand, and pebbles derived from the rocks mentioned, scattered through the soil and subsoil, and found lying upon the surface. The gravels and boulders of the glacial soil are derived from the Kansan till, and are identical with those of southwestern Minnesota and western Iowa. Although several lobes of the Kansan glacier reached within a short distance of the Wakarusa, the tills are much thicker and much less eroded farther north.

The residual soils, that is, those derived by the decomposition of the underlying rocks, are clays or clay loams of fine texture and low permeability. Shales are the predominating feature of the bedrocks, and have contributed accordingly to the present residual soil, to which they lend their original colors to a certain extent. The soils thus derived have been characterized by Byers et al., (1911) as

silty clay loams, and they vary in color from a light yellow to black. This soil obtains as a rather thin mantle, seldom exceeding 14 inches in depth, even where erosion has been controlled. In many localities, excessive and uncontrolled erosion has exposed the impervious "hard-pan" which makes up the underlying subsoil.

The bottom land soils, or those of alluvial origin, are heavy, black, silty loams, very tenacious and heavy when wet. Much of the wide valley is apparently mantled with terrace deposits, although Byers et al., considered them residual soils. These flat terrace deposits are referred to locally as "second bottom lands." The presence of decomposed limestone in the soil, and the relative deficiency in sandstone, lends to the formation of soils rich in calcium, and thus suitable for the growth of mollusks (Byers and Throckmorton, 1913).

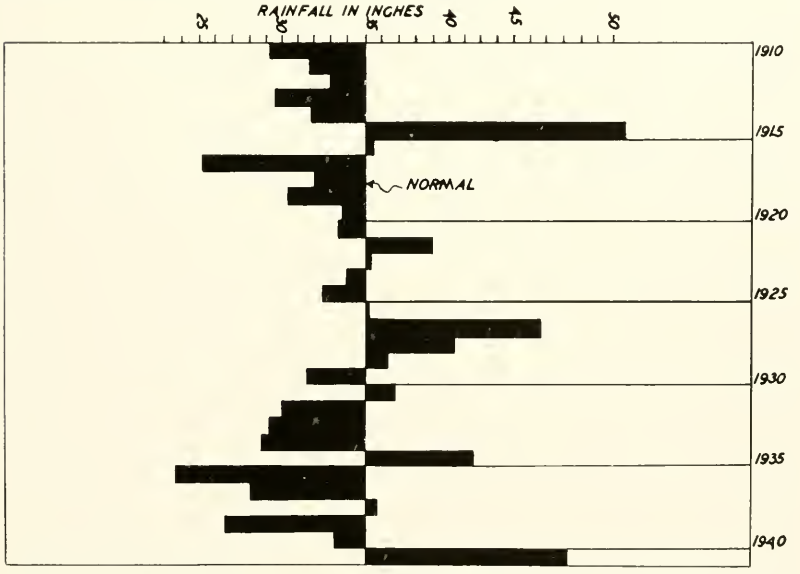
Originally, the high plateau areas and higher valley slopes were prairies of mixed grasses, but many of them have been placed under the plow or overgrazed so severly that weeds have replaced the original grasses. The drainage of the terrace flats was, under the conditions prevailing before the country was settled, very poor indeed. Shallow lakes and marshes were common, and sedges and aquatic grasses were the dominant type of vegetation. Roadside ditches, such as those selected as collecting station No. 8, remain filled with water throughout most of the year, and constitute the only remaining refuge for the molluscan life that once must have made up a conspicuous feature of the fauna of the marshes.

Eary writers remark upon the absence of trees in the vicinity of Lawrence, and in the Wakarusa valley. At the present time, the shores of the Wakarusa and its tributaries and the hillsides of the valley are more or less covered with trees and shrubs, apparently as a result of the plantings made by settlers within the last century. Along the Wakarusa itself, cottonwood, elm, oak, and black walnut are common trees, while on the hill slopes good stands of oak, hickory, together with elm, walnut, buckeye, redbud and other trees of lesser importance produce suitable habitats for terrestrial gastropods. Coralberry, wild grape, gooseberry, currant and other shrubs and vines are common among the trees. The coralberry is especially common among the woodlands, particularly in low, moist areas. In undisturbed areas, now reduced to a few scattered and isolated localities, leaf-mold and dead trees have been allowed to accumulate sufficiently to produce ideal habitats for woodland snails.

The mean annual temperature of the area ranges around 55° F., but the extremes are quite variable. During the summer months long periods of extreme heat are not uncommon. The summers of

the 11-year period from 1930-1941 were marked by prolonged periods of extremely high temperatures, scarcely interrupted by occasional torrential rains. In 1936, a temperature of 121° F. was recorded for the state. Winter extremes are not so severe, —20° F. being about the lower range for this area.

The mean annual rainfall is about 35 inches, but is subject to unpredictable variations. For example, the rainfall for the area was, in 1906, 34 inches; in 1920, 33.87 inches; and in 1941, 47.28 inches. Unfortunately, in years of even average rainfall, the greater part of the annual precipitation may occur in May and June, producing heavy floods in the streams, followed by a period of drought and extreme heat in July and August. In 1936, the precipitation for the state was: April, 1.3 inches; May, 4.88 inches; June, 1.26 inches; July, .86 inches; August, 1.06 inches; September, 4.84 inches. Periods of low rainfall such as in June and July, 1936, caused the Wakarusa to be hardly more than a series of isolated pools which naturally limited both the dispersal of naiads and the fish hosts of the larval stage. The fact that periods of high temperatures tend to occur with periods of very low precipitation has been unfavorable for molluscan life, especially aquatic forms. Text figure 1 shows annual rainfall for this area from 1910 to 1941, inclusive, and annual departure from the normal of 35 inches (Flora, 1941).



TEXT FIG. 1. Summary of annual precipitation in eastern division of state, showing departure from normal.

Eastern Kansas feels the effect of the cyclic periods of drought and heavy rainfall which are characteristic of the areas west of the Mississippi. The temperatures of the summer months of the last two years have not been extremely high. The rainfall has been somewhat above normal and there have not been the periods of drought. The indications are that this area is now in a weather cycle which will be more favorable for mollusean life and its dispersal.

RECENT CHANGES IN THE ENVIRONMENT OF THE AREA

Irrevocable changes have occurred in the local environment along the Wakarusa river and its valley in relatively recent times. Exploitation of the land has resulted in the destruction of the woodlands, overgrazing has destroyed much of the shrub and grass cover, tillage has resulted in severe and extensive erosion of many of the valley slopes, and fires set to burn dead grass, weeds and underbrush have further removed the natural cover of the land. As mentioned above, most of the marshes have been drained, and placed under cultivation.

In addition to these factors, all of which have had a deleterious effect upon the mollusean population, the area at the time this study was begun, had just passed through a period of drought and extreme summer heat, which extended over ten years or more. Many ponds and marshes had been dry for several years, many springs had ceased flowing, the leaf-mold of the woodlands had been very dry for several years, except for brief periods of rainfall.

The cutting of the woodlands, heavy grazing of the grassland, drainage of the marches, and extensive cultivation of the valley slopes have increased the rate of runoff after the torrential rains which occur at times in eastern Kansas, even during periods of relative drought. These factors, together with the rugged nature of the terrain over much of the drainage area, result in extensive erosion of the valley slopes, and violent flood in the streams. At flood stage the Wakarusa scours its channel and floodplain upstream, and deposits heavy loads of silt downstream. The latter feature is aggravated by the fact that often the Kansas river is in flood at the same time, obstructing the outflow from the Wakarusa, and reducing its competency for transporting the suspended silts eroded from the fields and valley slopes. Thus during flood periods, the Wakarusa either scours its banks clean of vegetation and animal life, or buries both under a heavy mantle of tenacious black silt, which may vary in thickness from a few inches to several feet.

PELYCOPODA

REVIEW OF LITERATURE

In 1884, under the direction of F. W. Cragin, of Washburn College, Topeka, Kansas, a biological survey of the state, sponsored by Washburn College, was begun. In September of the same year, the first number of the Bulletin of the Washburn Laboratory of Natural History appeared, and included with the Bulletin was the first report on the progress of the Washburn Biological Survey of Kansas. A wide variety of studies was reported, including papers on lichens, algae, mosses, and fungi. The second report, dated January 15, 1885, contained two papers by R. Ellsworth Call, one (1885), a description of a new species of *Unio* from Kansas; the other (1885 a) a list of 35 species of freshwater naiad mussels and 4 species of *Sphaerium*. The third report by Call (1885 b), listed 15 species of naiades not previously reported. Call's next study (1885 c) listed 5 species of naiades 2 species of *Sphaerium*, and a single species of *Pisidium*, not previously reported, and gave additional locality data on forms previously reported. In his fifth report, Call (1886) discussed in general terms the problems of distribution of mollusca in western Kansas, compared the pelecypod faunas of the Ohio and Arkansas river drainage basins, recorded 5 species of naiades new to the Kansas fauna, and gave additional locality data on a number of others. The sixth and last contribution by Call (1887) on the subject of Kansas mollusca again reported 4 fresh-water mussels new to the Kansas faunal assemblage, and new locality records were given for many additional forms.

Nothing further was added to the literature on the naiades of Kansas until 1906, when Scammon (1906) published an illustrated catalogue of the Kansas UNIONIDAE. Scammon's catalogue contained 61 species and 5 subspecies. The lists of both Call and Scammon contain many synonyms which reduces considerably the actual number of species.

Unfortunately it is not possible to make comparisons between the present unionid fauna of the Wakarusa and that of the early part of the century since Scammon failed to report specific locality data.

Since Scammon published his catalogue there have been no further contributions to the literature on the UNIONIDAE of Kansas.

Although not dealing with the fauna of the state of Kansas, the most exhaustive study of the naiades of any region west of the Mississippi was made by Utterback (1916), who published a catalogue of the naiades of Missouri, in which he listed and described

80 species and 20 subspecies. It is probable that a number of his reported forms are synonyms.

With each species is included one or more references to easily available literature. These are intended as a convenience to the reader, and should not be construed as a synonymy of the species.

METHODS OF COLLECTING AND PRESERVING NAIAD SPECIMENS

Early in the summer of 1942 a survey was made of the Wakarusa river from near the headwaters to its mouth, and a series of sites was selected for further study. The presence of dead shells cast upon the shoals often served as a clue to the location of naiad colonies.

At low-water stages the Wakarusa is relatively clear, so that mussels on the shoals and sand bars are easily visible, and can be observed and collected at leisure. In the deeper waters above shoals the turbidity is sufficient to make collecting more difficult. Here one must feel along the bottom of the stream with the fingers or toes, and in many places it is necessary to dive in order to collect some species of mussels. This is true of such forms as *Quadrula quadrula*, *Tritogonia verrucosa*, and others that prefer deep water.

As naiades were collected they were placed in burlap bags in which was also placed a field tag, giving all important data, and a duplicate record was kept in a field book. In the laboratory, treatment varied with the intended use of the specimens. If the animal was to be preserved with the shell, the mussels were drowned in water which had been heated to drive off the oxygen, and then cooled to about 120° F. Under these conditions mussels die relaxed, and can be preserved in formalin in an extended condition. If the shells alone were to be preserved, the mussels were placed for a few minutes only in boiling water. The bodies may be removed easily after such treatment. Soaking the shells in a solution of oxalic acid aids in removal of the encrustations of lime salts which frequently disfigure the shells, although scrubbing with a stiff brush is necessary. Discolorations on the nacre within the shell may be removed with a solution of hydrochloric acid, and the original polish of the nacre restored by use of a steel brush driven by a small electric motor.

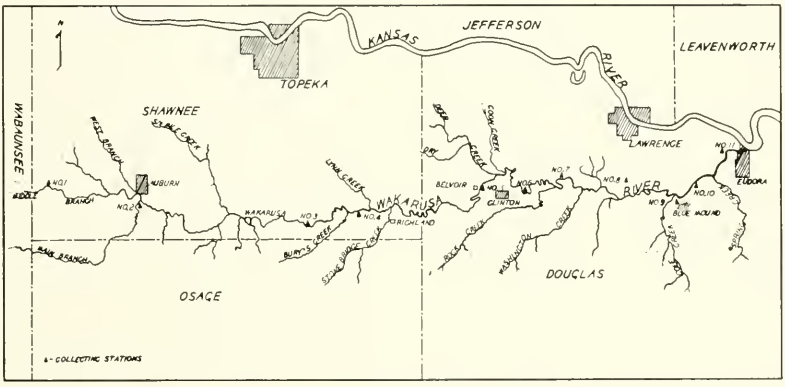
Large series of shells were kept in trays for study, and from these a suitable series of the better shells, representing various growth stages wherever possible, was selected for preservation in the files of the mollusean collection. These series were assigned their respective

numbers, and duly filed in the collections of the Natural History Museum of the University of Kansas.

COLLECTING STATIONS

Station No. 1: Six miles west, one-half mile south of Auburn.

At this station the Wakarusa is a small brook, flowing among the rolling hills which form the chief topographical feature of the eroded plateau of western Shawnee county. At places the stream is only a few feet wide, and shallow where it flows over bars of coarse gravel; upstream from limestone ledges the brook stands in quiet pools which are 8 or 10 feet wide and several feet deep, with a soft



TEXT FIG. 2. Map of Wakarusa river, with locations of collecting stations.

mud bottom. An interesting feature of the stream at this station is a canal about 30 feet deep and approximately 100 yards long, cut through the yellowish-green shales and a limestone ledge, which was made in an effort to straighten the channel. The canal bed is barren of all life, but pools which are remains of the abandoned stream channel contain an abundant growth of filamentous algae, with *Physa* present in large numbers. Nowhere in the stream are conditions very favorable for mollusks due to the almost complete absence of aquatic vegetation and the trampling by livestock. The alluvial flats which flank the stream, when not under cultivation, support a fair stand of trees consisting largely of elm (*Ulmus fulva*), occasional sycamores (*Plantanus occidentalis*), and sparse underbrush. There is scarcely any leaf-mold or dead wood, the scattered clumps of coralberry (*Symphoricarpus orbiculatus*), and aromatic sumac (*Rhus* sp.), and the rocky ledges along the south bank of the

stream afford the only available habitats for terrestrial snails. The treeless grassy hills are heavily pastured, and this practice, together with the custom of burning over the pastures in the spring, has almost extinguished the original molluscan fauna of the uplands.

Station No. 2: One-half mile south of Auburn.

Here the Wakarusa is a larger stream, 15-20 feet wide, and about 2 feet deep at low-water stage. It has cut a rather deep, narrow channel through its own alluvial deposits. The bottom is composed of coarse Pennsylvanian gravels, although some of the deeper pools have a bottom of soft mud. Shoals and gravel bars are common, and occur at every meander of the stream. The water is clear, or only slightly colored with microscopic algae, at low-water stage, but very turbid at high-water level. There is almost no acquatic vegetation, due to the scouring action of the stream and the rate of the current. The floodplain is well timbered, the most common trees being the elm (*Ulmus fulva*), sycamore (*Plantanus occidentalis*), box elder (*Acer negundo*), white ash (*Fraxinus americanus*), honey locust (*Gleditsia triacanthos*), red mulberry (*Morus rubra*), hackberry (*Celtis occidentalis*), pin oak (*Quercus palustris*), shagbark hickory (*Carya laciniosa*), with elderberry (*Sambucus canadensis*), and coral berry (*Symphoricarpus orbiculatus*), forming a sparse underbrush. The flood plain has very little leafmold or other cover for snails due to frequent flooding which strips it bare or buries everything under mud and sand. Conditions in the stream are rather favorable for naiades, but the most successful mollusk at this station is a species of *Sphaerium,* the shells of which are numerous everywhere among the gravels.

Station No. 3: Three miles east of Wakarusa.

A shoal of rock and shingle forms a conspicuous feature of this station; otherwise the stream here is about 50 feet wide and 5-10 feet or more in depth. Except at the shoal the bottom is of mud, frequently quiet soft and mucky. The channel banks are high, there being no real flood plain, but the stream rises frequently to increase its depth 20-30 feet, and sweeps the channel banks clean of leaf mold, and other vegetation suitable for snails. The banks of the stream and the adjacent steep slopes on the south are well timbered. In addition to the trees noted at Station No. 2, the cottonwood (*Populus virginianus*), black walnut (*Juglans nigra*), and bur oak (*Quercus macrocarpa*), are common. Underbrush is scant, but includes the dogwood (*cornus* sp.), and elderberry (*Sambucus canadensis*). The alluvial flats to the north of the stream are under cul-

tivation, but the steep slopes to the south are relatively undisturbed, except for almost annual burning.

The shoals mentioned are favorable for naiades which were relatively abundant. Muskrats were seen, but little evidence of destruction of mussels by them was apparent.

Station No. 4: Six miles east of Wakarusa.

At this station the stream is both wider and deeper than before, averaging about 75 feet in width, and 10-15 feet in depth at low water. There are occasional rocky shoals, or gravel bars, which provide suitable habitats for naiades, but much of the bottom of the stream at this station is covered with soft mud. The channel banks are 20-30 feet high, and while well-timbered, are almost bare of underbrush or other cover for snails. The willow (*Salix* sp.), not common above this point, is numerous here; likewise, the osage orange (*Maclura pomifera*), and bitternut hickory (*Carya cordiformis*) appear for the first time. Additions to the list of shrubs previously noted include green brier (*Smilax hispida*), common here, and the pawpaw (*Asimina triloba*). The wild grape (*Vitis* sp.) is also frequently encountered. Near the stream conditions are unfavorable for terrestrial snails, due to the lack of sufficient and proper cover, but the timbered hills near by support a rather varied fauna. The alluvial flats adjacent to the north are nearly all under cultivation, but along a small tributary there is a good growth of undisturbed timber, with thick leaf mold and much fallen wood. The soil remains moist here even in relatively dry weather, and snails are abundant.

Station No. 5: One-half mile east of Belvoir School.

At this station the stream is narrower than at No. 4, seldom exceeding 35 feet in width. The current is relatively rapid, the depth of the water about 4 feet. The bottom is fine gravel or mud, but a rocky shoal is found near Belvoir bridge, where several species of naiades live. Nearly all the land near by is under cultivation, trees are almost absent, although a few black maples (*Acer nigrum*), elm, willows and black walnuts may be found at intervals. A small, entering ravine, its slopes a thicket of elm sprouts, provides the only available and suitable habitat for land snails. Aquatic snails are rare, there being little vegetation in the water, and much scouring action by the narrowed stream. In these reaches of the stream microscopic algae are abundant at nearly all seasons, a condition which perhaps is favorable for naiades.

Station No. 6: One and one-half miles east of Clinton.

The Wakarusa meanders widely at this station; the water is about 3 feet deep over the rocky or gravelly shoals, but much deeper in the intervening quieter pools, where it was necessary to dive in order to collect mussels. The bottom is largely of firm mud, which many naiades seem to prefer, but others were found living on the shoals of limestone, shingle, and cobble. Gravel bars are infrequent, but where found, support a good naiad fauna. No aquatic gastropods were discovered.

The channel banks, which are 25-30 feet in height, are almost bare of vegetation, except for a rank growth of the giant ragweed (*Ambrosia trifida*). Throughout these reaches of the stream the channel banks are heavily mudded by overflows and no terrestrial gastropods find it possible to exist, but higher slopes are timbered, littered with leaf mold, fallen wood, and other cover for snails. The timber consists of willow, sycamore, elm, black maple, honey locust, and white ash, with dogwood, coralberry, elderberry and wild blackberry (*Rubus* sp.), the most common shrubs.

The turbidity of the stream is intensified at this place. At high-water stages this is due to the enormous loads of silt transported after heavy rains, and at low-water levels to an abundant growth of microscopic algae.

Station No. 7: Four miles east, one mile north of Clinton.

At this station the Wakarusa flows between steep mud banks more than 30 feet above the normal water level. Several rocky shoals and bars of coarse sand and gravel provide a habitat for mussels, while the firm mud bottom supports colonies of *Amblema costata*, and *Proptera alata*, with lesser numbers of *Quadrula quadrula* and *Tritogonia verrucosa*. The depth of the water varies from a foot or two over the shoals and bars up to 8-10 feet in the quieter pools. There is a moderate current, even at low-water stage.

The banks of the stream support trees in fair numbers, but since rises in the stream of 25 feet or more are not uncommon, heavy deposits of fine silt prevent growth of other vegetation, and no molluscan life is possible. However, on an adjacent terrace, which supports a good stand of elm, black walnut, Kentucky coffeeberry (*Gymnocladus dioica*), and sycamore trees, with undergrowths of coralberry, Virginia creeper (*Parthenocissus quinquefolia*), and elderberry, is provided a suitable habitat for terrestrial gastropods. Fallen logs, heavy accumulations of leaf mold, and favorable moisture conditions lend themselves to the support of a rather varied molluscan fauna. *Euconulus*, *Retinella*, *Zonitoides*, *Gastrocopta*, and *Anguispira*, are the most common forms living here.

Station No. 8: Two miles south, one mile east of Lawrence.

This station, consisting of roadside pools located in Haskell bottoms, was selected to represent a type of habitat found widely throughout the Wakarusa valley. The terrain is a flat, featureless, poorly drained terrace, which in former times was covered with great marshes. These have been drained with a fair degree of success, but except in a very few dry periods, roadside ditches stand full of water. Aquatic grasses and sedges grow tall and rank, and the water supports a rather rich aquatic fauna, including several species of gastropods. *Helisoma trivolvis* and *Physa hawni* are prevalent and numerous in these ditches almost everywhere, but *Lymnaea bulimoides techella*, locally abundant, is erratic in its distribution. *Succinia grosvenori* is commonly found moving about on the grasses and sedges near or above the water, but like *L. bulimoides techella*, it is erratically distributed. An example of this unexplained distribution occurred at this station, where a fence row partially separated a ditch by the road from a similar ditch in the adjacent field. Although the two pools were connected at several points, *Physa hawni* was found only in one pool and *L. bulimoides techella* was restricted to the other. Ecological conditions seem identical in both pools, but this curious segregation of the two species has been noted over a period of several years.

Station No. 9: Three and one-half miles south, two miles east of Lawrence.

This station occupies the lower northern slopes of Blue Mound, a hill which rises about 250 feet above the plain which flanks the lower part of the Wakarusa. If one may judge from the reports of Hanna (1909), this hill was formerly an ideal habitat for mollusks, but the destruction of the timber and the trampling of livestock has resulted in the apparent extinction of a number of species. The lower northern slopes, however, a belt about three-fourths miles long and several hundred yards wide, are relatively undisturbed. There is a good growth of timber, consisting of several species of oak, with hickory, black walnut, and buckeye (*Aesculus glabra*) completing the stand. Undergrowth of dogwood, redbud, sumac, elm sprouts and wild raspberry afford additional cover, and assist in forming a deep layer of leaf mold and twigs which covers the soil almost everywhere. Fallen logs and old stumps complete an almost perfect habitat for terrestrial snails, since moisture conditions are favorable, even in relatively dry intervals. *Euconulus*, *Strobilops*, *Retinella*, *Zonitoides*, and other small snails are commonly found.

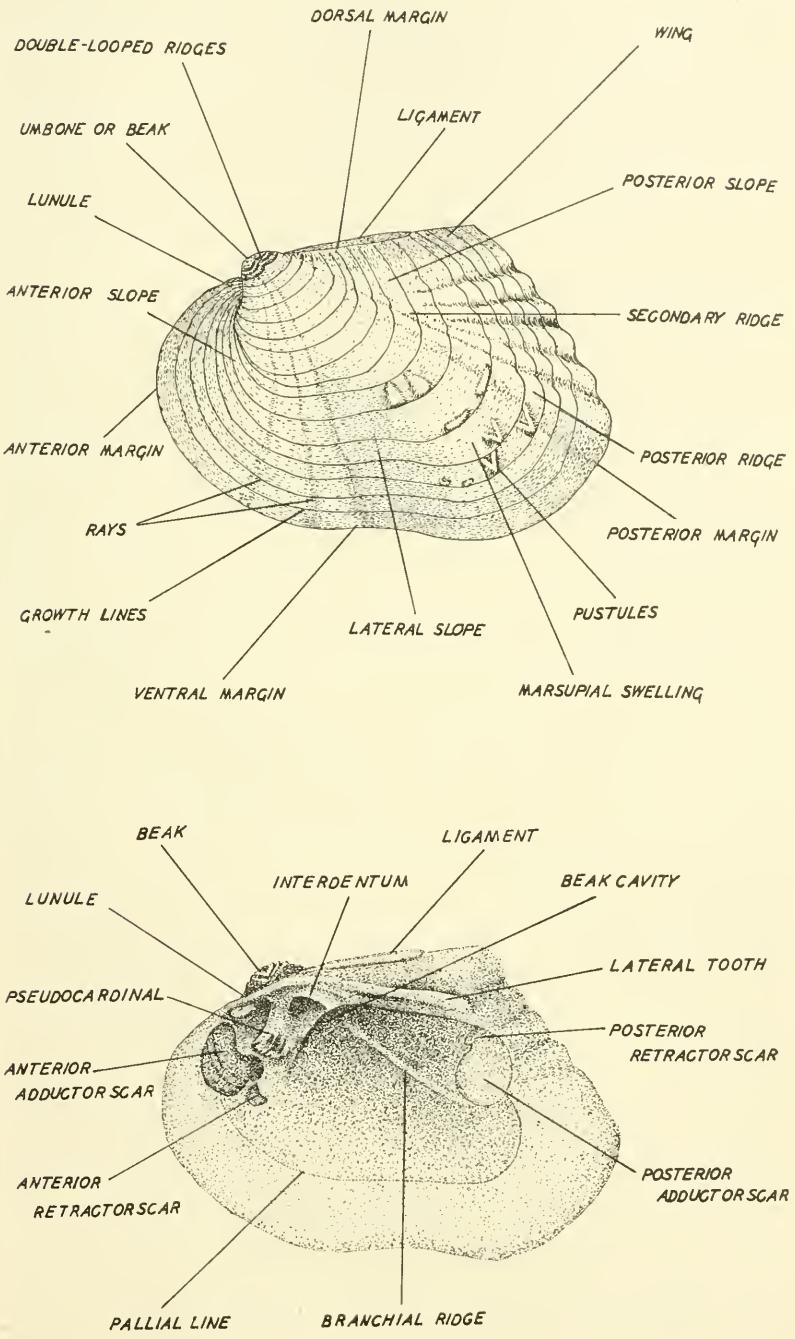
Triodopsis albolabris alleni, though not numerous, is widely distributed here, and several populous colonies of *Anguispira alternata* live in the cool, shaded ravines which dissect the slope.

Station No. 10: Three and one-half miles south, three miles east of Lawrence.

In the lower reaches of the stream, the Wakarusa becomes sluggish and meandering, flowing between steep, mud-covered banks. Silting is so serious that no naiades seem able to exist here, and the banks of the stream are distinctly unfavorable to gastropods, since they are buried under deep layers of heavy silt at rather frequent intervals as the stream rises. Occasionally a sharp meander of the stream leaves a narrow strip of land which has not been disturbed and this station is such an area. A good stand of large oaks, cottonwood, and elm trees, with a heavy undergrowth of coralberry, dogwood, and such herbs as Jack-in-the-pulpit, May apple, boneset, phlox, and nettles, with fallen logs, bark, and deep accumulations of dead leaves, comprise a favorable situation for gastropods. *Gastrocopta armifera* flourishes here in large numbers, together with such small woodland snails as *Zonitoides arboreus* and *Retinella indentata*.

Station No. 11: One-half mile west of Eudora.

At this station the Wakarusa is broad and deep, but heavily laden with silt, even at low-water stages. The bottom is of deep, mucky silt, and apparently supports no mussels whatever. The banks of the stream are steep and rather high, but so deeply mudded that little vegetation or other life is possible; no snails are found. A high floodplain, rarely under water, flanks the stream at this station. The flat is poorly drained, but well timbered with honey locust, black walnut, hackberry, elm, mulberry, wild plum, sycamore, and box elder; the underbrush consists of rank growths of coralberry, wild gooseberry, elderberry, wild grape, and greenbrier. Although parts of the area are grazed by livestock, there is sufficient cover to support a considerable molluscan fauna. *Stenotrema, Retinella, Zonitoides, Strobilops,* and *Deroceras* are especially common here, where they may be found under and near the old stumps and fallen logs which litter the ground at this station.



TEXT FIG. 3. Diagrams of named parts of naiad shell.

CLASS PELECYPODA

ORDER PRIONODESMACEA

Superfamily NAIADACEA

FAMILY UNIONIDAE

Truncilla donaciformis (Lea) "Fawn's foot"

(Plate XXVIII, Fig. 3, Cat. No. 913)

Baker, 1928, pp. 228-231.
Call, 1885, Vol. 1, No. 3, pp. 96, 180; Vol. 2, pp. 20, 23.
Scammon, 1906, pp. 310-312.
Simpson, 1914, pp. 308-309.

The shell is small, subsolid, elongate ellipsoid, somewhat inflated, and inequilateral. The beaks are fairly high, flattened, and directed downward; they bear a few double-looped ridges. The posterior ridge is sharply defined in the region of the umbones but becomes somewhat broadened as it approaches the posteroventral angle. The dorsum of the posterior slope is broad and almost horizontal, forming a wide, flattened escutcheon. The dorsal margin is short, straight, sloping obliquely downward to meet the posterior margin at a broad angle. The stout, olive green or brown ligament occupies the posterior half of the hinge line. The posterior margin slopes obliquely downward, is slightly rounded and meets the ventral margin at a sharp angle. The broadly rounded ventral margin is continuous with the rounded anterior margin. The surface of the shell is marked with fine concentric growth lines which tend to become coarser toward the periphery of the shell. Sometimes fine corrugations appear along the posterior slope. The epidermis is a yellowish green with a pattern of dark green or brown rays which are frequently broken up into 'v's,' inverted 'v's,' arrowhead shapes, or zigzag markings which extend over the lateral slope, posterior slope, and the rather broad escutcheon. In the left valve are two large, compressed, broadly triangular pseudocardinals, slightly sulcated along the margins. The two laterals are long, high, and sharp; they originate near the pseudocardinals. The upper lateral is somewhat smaller and shorter than the lower. In the right valve is one large, compressed pseudocardinal, finely sulcated along the margins. The single lateral is long, sharp, and begins near the pseudocardinal. The anterior adductor muscle scar is large, smooth, but deeply pitted at the base of the pseudocardinals, scarcely separated from the smaller, shallow retractor scar, which is located very near the anterior margin. The posterior adductor muscle scars are somewhat larger, very faint and indistinct. The faint posterior retractor scar

is confluent below with the posterior adductor scar. The pallial line is distinct below the anterior adductor scar, but becomes quite obsolete posteriorly. The beak cavities are shallow and sharply rounded; pitted above by a small series of visceral muscle scars. The branchial ridge is low, rounded, but distinct, and extends to the ventral margin of the posterior adductor scar. The nacre is tinted with blue or salmon and becomes iridescent toward the posterior and ventral margins.

Occurrence. Rare in the Wakarusa, only a single, dead, but unworn, shell was discovered. Rather common in the Marais des Cygnes river.

General distribution. Western Pennsylvania, west to Kansas, north to Minnesota, south to eastern Texas and Alabama.

Length	Heigth	Diameter	
33 mm.	19 mm.	16 mm.	
39	22	17	(Marais des Cygnes)
33	20	16	(Marais des Cygnes)

Lampsilis siliquoidea (Barnes) "Fat Mucket"

(Plate XXVIII, Fig. 1, Cat. No. 914)

Baker, 1928, pp. 270-275.
Call, 1885, Vol. I, No. 3, pp. 96, 120, 181; Vol. II, p. 21.
Scammon, 1906, pp. 287-288.
Simpson, 1914, pp. 60-63.

The shell is moderate to large in size, elliptical to obovate, strongly inequilateral, thin to subsolid, somewhat inflated to inflated; adult females strongly inflated. The beaks are raised only slightly above the dorsal margin: they turn inward and only slightly forward. They are sculptured with a series of rather fine but distinct ridges: the ridges near the apex of the beaks are double-looped, but those toward the periphery of the nepionic shell are undulate but single-looped. The beaks of local specimens are almost always badly worn. The posterior ridge is low, rounded and almost indistinct. The dorsal margin is almost straight, the greater part occupied by the stout, dark brown to black ligament. In males the posterior margin is rounded, somewhat drawn out; in females, it is indented anterior to the marsupial swelling. The anterior margin is narrowly rounded. The annual or seasonal growth lines form rather prominent ridges which are paralleled by numerous fine striations. Delicate lines composed of a series of branched or looped ridges radiate from the beaks, extending over the anterior and lateral slopes. The epidermis is smooth, except that as the animals increase in age the surface may become rough and scaley especially

toward the periphery. The color varies from dull yellow to brown: the annual growth lines are frequently much darker. Dark greenish lines, varying in width over the surface of the shell, radiate from the beaks, although they are obsolete over much of the posterior slope and may be entirely lost in old specimens.

In the left valve are two, compressed, triangular pseudocardinals: the anterior is higher, often columellar; the posterior may be rougher and greatly reduced. The paired laterals, straight to slightly curved, are thin, increased in height posteriorly, diminishing gradually near their terminations. They are separated by a deep, narrow groove. In the right valve the two pseudocardinals are likewise serrate, but in this valve the posterior is much the larger; the anterior tooth is reduced or almost wanting. The single, high, lamellar lateral increases in height posteriorly and is abruptly truncated at its termination. The anterior adductor scar, broadly convex in front, narrows and becomes more deeply impressed near the anterior pseudocardinal. It is almost smooth except for a rounded ridge along the ventral border which separates this depression from the much smaller, distinctly impressed anterior retractor scar. The posterior adductor scar is larger, rounded to elongate, confluent above with the much smaller posterior retractor scar: both are scarcely impressed, but distinct. The pallial line is rather remote, deeply impressed anteriorly, but it may be quite indistinct posteriorly. The beak cavities are shallow and contain a series of four or five visceral muscle scars. The branchial ridge extends from the posterior part of the beak cavities to the lower border of the posterior adductor scar. The nacre is bluish-white or white, sometimes richly suffused with salmon. Iridescence is a conspicuous feature of shells with a bluish-white nacre, but all shells tend to be iridescent posteriorly.

Occurrence. Only a small series of dead shells was found in the Wakarusa, though from observations, and the reports of Scammon a widespread occurrence in the state is probable. It is fairly abundant in larger streams in Kansas.

General distribution. Mohawk river, N. Y., west to Iowa and Kansas, north to Ontario and Minnesota, south to Oklahoma, Kentucky, and West Virginia.

Length	Height	Diameter	
129 mm.	67 mm.	55 mm.	
119	59	48	(Marais des Cygnes)
120	58	45	(Marais des Cygnes)

Lampsilis anodontoides (Lea) "Yellow-sand Shell"

(Plate XXIX, Fig. 12, Cat. No. 912)

Baker, 1928, pp. 266-268.
Call, 1885, Vol. I, pp. 96, 119, 180; Vol. II, p. 19.
Scammon, 1906, pp. 291-293.
Simpson, 1914, pp. 90-91.

The shell is of moderate size, subrectangular, strongly inequilateral, solid, thickest anteriorly, considerably inflated and gaping somewhat at both ends. The beaks are somewhat inflated, raised slightly above the hinge line, directed forward and marked with a series of distinct ridges looped upward in the mid-line and directed downward toward the posterior ridge. The posterior ridge is low and rounded and extends backward almost parallel with the dorsal margin. The escutcheon is long, fusiform, and almost horizontal. The dorsal margin is long and slightly convex, the posterior two-thirds occupied by the brown to dark brown ligament. The posterior margin is angulate above and rounded below in females, while in males the posteroventral margin is drawn out into a rather sharp angle. In females the ventral margin is nearly parallel to the dorsal margin, and somewhat arcuated by the depression anterior to the marsupial swelling. In males the ventral margin is broadly rounded to the posteroventral angle. The anterior margin in both sexes is shortly rounded. The surface is marked by prominent growth lines, sometimes rather close; in older shells the later growth lines are more prominent, often forming strong, roughened ridges. Fine striations between the growth lines give the shell a silky appearance. The epidermis varies in color from straw-yellow through light olive green to medium brown; young shells are frequently ornamented with green to brownish radiations particularly on the posterior slope. The rays become faint or disappear entirely in older shells. The escutcheon is a smoky black in older shells and this color frequently appears along the heavier growth lines.

There are two subcompressed, triangular, slightly sulcated pseudocardinals in the left valve. The anterior is broader and higher but placed somewhat lower than the posterior one. The two laterals are long, high and narrow; the ventral is somewhat higher than the dorsal tooth. The right valve also contains two pseudocardinals; the posterior triangular to subtriangular, sulcated, heavier and higher than the anterior tooth which is compressed and lower, often obsolete. The single pseudocardinal is long, high, sharp, and truncated behind. The anterior adductor scar is smooth, shallow in front and deeply impressed behind; a rounded ridge separates it

below from the small, impressed, anterior retractor scar. The posterior adductor scar is larger, smooth, shallow, but distinctly impressed and confluent above with the posterior retractor scar. The pallial line is distinct anteriorly, diminished somewhat posteriorly. The shell tends to be somewhat roughened below the pallial line. The beak cavities are shallow and marked with visceral muscle scars anteriorly; posteriorly the branchial ridge is distinct. The nacre is white, or bluish-white in young specimens, frequently tinged with salmon or pink, especially toward the beak cavities, and iridescent posteriorly.

Occurrence. Common in the Wakarusa, as well as in other streams of the state. *Lampsilis anondontoides* thrives in streams of all sizes, and is frequently found in small tributaries.

General distribution. Entire Mississippi drainage, except possibly the upper Missouri. All Gulf drainage from Withlacoochee river, Florida, to Rio Grande, and into México.

Length	Height	Diameter	
122 mm.	56 mm.	45 mm.	(♂)
120	52	45	(♀)
96	42	36	(♀)

Ligumia subrostrata (Say)

(Plate XXIX, Fig. 10, Cat. No. 904)

Baker, 1928, pp. 300-301.
Call, 1885, Vol. I, pp. 94, 122, 182; Vol. II, p. 23.
Scammon, 1906, pp. 295-297.
Simpson, 1914, pp. 98-102.

The shell is moderately small, thin to subsolid, elongate, and ellipsoidal but divergent in the two sexes, somewhat inflated, and strongly inequilateral. The beaks, which are only slightly elevated above the dorsal margin, are sculptured with a series of ridges which are sharply drawn up in the middle. The beaks are directed inward and only slightly forward. The posterior ridge, angulate anteriorly, becomes less elevated and more rounded, and terminates on the posterior margin in a rounded angle. In females the termination of the posterior ridge is higher, the angle more obtuse. The dorsal margin is slightly convex; the posterior two-thirds is occupied by the rich brown to blackish ligament. The posterior margin is drawn out to a rounded angle in males: in females this margin is broadly truncate, sloping forward slightly below. The ventral margin is straight to slightly convex in males, straight or somewhat indented anteriorly to the marsupial swelling in females. The anterior margin

is narrowly rounded in both sexes. Superficially the surface is smooth, except for the growth lines and less prominent parallel striations; but under low magnification a series of fine, irregular, intricately branched and anastomosing ridges, radiating in groups from the beak, are revealed. Color varies through light olive green, dull greenish brown, mahogany to blackish. A series of dark greenish lines, varying in width in different specimens, radiates from the beaks, especially over the lateral and posterior slopes. Many specimens are faintly rayed or rayless, and in the local series there seems to be little correlation between age and size, and presence or absence of rays.

The left valve contains two very compressed, triangular, serrated, pseudocardinals which are frequently united at the base, and two long, lamellar laterals which increase in height posteriorly except at their terminations where they decrease more or less abruptly. The right valve frequently contains two pseudocardinals; the posterior, large, compressed, triangular and serrated; the anterior, when present, is much reduced, and occupies a position along the hinge line. The single lateral is long, high, and narrow and terminates more or less abruptly. The anterior adductor muscle scar is smooth, rounded in front, greatly narrowed behind where it is also much deeper: a rounded ridge separates it below from the much smaller anterior retractor scar. The posterior adductor scar is larger, scarcely impressed, smooth, and confluent above with the much smaller posterior retractor scar. The pallial line is rather remote, not well impressed. The beak cavities are pitted above with a series of visceral muscle scars. The branchial ridge is narrow, scarcely sharp and extends obliquely backward to the ventral border of the posterior adductor scar. The nacre is white, bluish white, sometimes tinged with cream or salmon, more or less iridescent throughout, and increasingly so posteriorly.

Occurrence. Present in fair numbers at station 6, otherwise rare in the Wakarusa. Scammon reported it as common in all the small streams of the eastern half of Kansas.

General distribution. Eastern Texas, as far north as 41° N. Latitude, in Mississippi drainage.

Length	Height	Diameter
56 mm.	29 mm.	19 mm.
67	32	24
44	20	16

Carunculina parva (Barnes) "Liliput Shell"

(Plate XXVIII, Fig. 4, Cat. No. 916)

Baker, 1928, pp. 251-253.
Call, 1885, Vol. I, pp. 96, 120; Vol. II, p. 22.
Scammon, 1906, pp. 298-299.
Simpson, 1914, pp. 151-152.

This shell is the smallest of the UNIONIDAE in the state of Kansas. It is obovate to subrectangular, somewhat inflated, strongly inequilateral, and gaping slightly anteriorly. The beaks are full but raised only a little above the dorsal margin. They are directed forward and marked with a series of about 5-6 heavy, single-looped ridges which are turned upward posteriorly. The posterior ridge, low and sharp anteriorly, disappears into the posterior slope. A narrow ridge parallels it dorsally. The dorsal margin is long, straight to slightly convex: the posterior two-thirds is occupied by the long, dark brown ligament. The posterior margin is obliquely truncated above and broadly rounded below into the ventral margin. The latter is almost straight or slightly indented just anterior to the marsupial swelling. The anterior margin is broadly rounded. Rather coarse growth lines are paralleled with fine striations. The epidermis is heavy, and becomes increasingly rough and scaley with the growth of the shell, giving the surface a dull appearance. The eradiate shell is brown, sometimes tinged with dark olive green, or quite black.

In the left valve are two compressed, triangular, serrated, rather heavy pseudocardinals which are erect or sometimes recurved toward the hinge line. They are connected at their bases by a broad, low, irregularly serrated ridge. The paired laterals begin near the posterior pseudocardinal and extend to the posterior limits of the dorsal line. They are somewhat curved; the dorsal low and smooth, the ventral twice as high and roughened. Both the pseudocardinals and the laterals are strong teeth for a shell of this size. The anterior adductor muscle scar is pyriform; the anterior portion, more deeply impressed posteriorly, is broadly oval and smooth; the posterior portion, much narrower and of less than half the height, is rough and pitted, and excavated beneath the pseudocardinal. The adductor scar is separated by a rounded ridge below from the much smaller, rather deeply impressed anterior retractor scar which is higher than long. The posterior retractor scar is large, and smooth, distinctly but not deeply impressed, confluent with the much smaller, rather deeply impressed anterior retractor scar which is higher than long. The posterior retractor scar is large, and smooth, distinctly but not deeply impressed, confluent with the much smaller retractor scar

which occupies a position just below the termination of the lateral. The pallial line is remote, more deeply impressed anteriorly, though generally distinct throughout. The beak cavities are shallow, and typically they contain a series of 4-6 distinctly impressed visceral muscle scars; the largest near the hinge line behind the pseudocardinal; the rest in a diagonal line directed downward and forward. The branchial ridge is broadly rounded, frequently indistinct. The nacre is bluish white, sometimes tinged with cream and generally iridescent.

Occurrence. While Scammon reported this tiny shell as common in all the streams of eastern Kansas, it is apparently not common in the Wakarusa. A small series was collected at stations 2, 3, and 4.

General distribution. Western New York, west to Iowa and Kansas, north to Minnesota, Michigan, and southern Canada, south to Oklahoma and Texas.

Length	Height	Diameter
20 mm.	12 mm.	8 mm.
22.5	13	8
23	13	9

Proptera alata (Say) "Pink Heel Splitter"

(Plate XXIX, Fig. 16, Cat. No. 907)

Baker, 1928, pp. 241-244.
Call, 1885, Vol. I, No. 4, p. 119; Vol. II, p. 19.
Scammon, 1906, pp. 299-300.
Simpson, 1914, pp. 162-164.

The shell is large, obovate, strongly inequilateral, solid, somewhat inflated, and gaping anteriorly. The younger shells are strongly alate; in older shells the wing is frequently broken or worn back. The beaks are low, scarcely inflated, directed forward over a small lunule, and marked with a few indistinct, irregular, ridges which tend to be worn in older specimens from local collections. The posterior ridge is low, narrow, but rather sharp in younger specimens. A second, similar ridge parallels the posterior ridge above. The dorsal margin is long and straight; it slopes obliquely downward in front due to the development of the wing behind the ligament. The latter is long and dark brown in color. The posterior margin is slopingly truncated above and rounds into the ventral margin below. The ventral margin is slightly convex and continuous with the rounded anterior margin which is somewhat drawn out. Rather heavy, and closely spaced growth lines are the only sculpturing on the surface. Fine striations parallel to the growth lines give the shell a silky appearance. Older shells are usually badly worn and the epidermis

tends to break and peel. The color varies from dull green to a medium brown in young shells, to a dark brown in older specimens. Young shells are often decorated with fine, green radiating lines.

In the left valve are two heavy, triangular, roughly sulcated pseudocardinals. The two laterals are of moderate length and distantly removed from the pseudocardinals. These teeth are high, sharp, but strong, increasing posteriorly; the ventral somewhat higher than the dorsal. There are two triangular, sulcated pseudocardinals in the right valve; the posterior much higher than the anterior. The single lateral is long, sharp, and strong, increasing posteriorly, and truncated behind, and like those of the left valve, distantly removed from the pseudocardinals. The anterior adductor muscle scar is distinct, smooth and deep dorsally, roughened posteriorly by strong ridges and separated below by a strong rounded ridge from the smooth, impressed anterior retractor scar. The posterior adductor scar is larger than the anterior, and shallow though distinct. The anterior retractor muscle scar is deep, smooth and irregular along its dorsal margin. The posterior retractor scar is confluent below with the posterior adductor scar and almost obsolete. The pallial line is remote, impressed anteriorly, but less distinct posteriorly. The beak cavities are shallow, and well-marked with rather large, irregular, visceral muscle scars below the umbones. The branchial ridge, narrow but distinct, extends from the beak cavity diagonally backward to the lower border of the posterior adductor scar.

Occurrence. Said not to be common in Kansas, but it is very abundant in certain reaches of the Wakarusa, especially on firm mud bottoms, in water several feet deep.

General distribution. All of Mississippi valley, as far south as Arkansas.

Length	Height	Diameter	
183 mm.	92 mm.	66 mm.	♀
160	92	54	♂
150	82	54	♀

Leptodea fragilis (Rafinesque) "Fragile Paper Shell"

(Plate XXVIII, Fig. 6, Cat. No. 915)

Baker, 1928, pp. 234-237.
Call, 1885, Vol. I, pp. 96, 120, 181; Vol. II, p. 21.
Scammon, 1906, pp. 302-303.
Simpson, 1914, pp. 181-183.

The shell is of moderate size, elliptical to obovate, strongly inequilateral, alate, thin, and brittle, somewhat inflated, gaping slightly anteriorly and posteriorly. Sometimes young shells have a slight

wing anteriorly which is worn down completely in older shells. The posterior wing becomes broken back with increased age of the animal. The beaks are low, compressed and scarcely elevated above the dorsal margin, marked with a few coarse double-looped ridges which are more evident posteriorly than anteriorly. They are frequently well worn down, especially in local specimens. The posterior ridge is narrow along the beaks but becomes broadly rounded and obscure posteriorly. Two or three sharp, narrow ridges radiate from the umbones over the posterior slope. The dorsal margin is straight and long, directed upward posteriorly with the golden to dark brown ligament occupying the posterior two-thirds. The upper portion of the posterior margin extends obliquely downward from the wing; the lower portion is rounded and continues into the broadly rounded ventral margin. The anterior margin is rather narrowly rounded. The surface of the shell is marked with widely spaced to crowded growth lines paralleled by fine striations. The color varies from straw-yellow to a golden brown. Sometimes dark bands follow the coarse growth lines. The posterior slope is dark brown. Frequently rather faint, dull green lines radiate over the rather shiny surface of the shell.

In the left valve are two or a single, small, serrated to smooth, compressed, sometimes feebly developed, pseudocardinals. There are two remote laterals separated by a narrow groove. The upper is long, sharp, and slightly curved; the lower is frequently equally as strong but sometimes only feebly developed. In the right valve is a single, compressed, serrated, pseudocardinal. The single lateral is remote, high, sharp, and long, and falls off abruptly posteriorly. The anterior adductor muscle scar is smooth, shallow anteriorly but somewhat impressed posteriorly. It is rounded in front and deeply arcuated just below the pseudocardinal. The lower margin is irregularly roughened, and a low, wide ridge separates this scar from the large, lunar, anterior adductor muscle scar. The posterior adductor muscle scar is very shallow, sometimes almost indistinct, broadly rounded below and confluent above with the small posterior retractor scar. The branchial line is low and extends obliquely backward to the ventral border of the posterior adductor scar. The remote pallial line is faintly impressed anteriorly and scarcely distinct posteriorly. The beak cavities are very shallow and marked below with a series of large, conspicuous visceral muscle scars. The white, glossy, nacre is variously tinted with pink, salmon, blotches of golden brown, and general iridescence.

Occurrence. No living specimens of this species were found and only two dead shells at station No. 6; however, these shells were not eroded and seem to offer evidence that this species, while rare, still occurs in the Wakarusa.

General distribution. Eastern New York and Ottawa river, west to Iowa and Kansas, north to Red river of the North, and south to Texas, Mississippi, and Alabama.

Length	Height	Diameter	
127 mm.	70 mm.	40	
115	58	35	(Marais des Cygnes)

Tritogonia verrucosa (Rafinesque) "Buckhorn"

(Plate XXVIII, Fig. 7, Cat. No. 901)

Baker, 1928, pp. 100-103.
Call, 1885, Vol. I, pp. 96, 122, 183; Vol. II, p. 23.
Scammon, 1906, pp. 313-314.
Simpson, 1914, pp. 318-321.

The shell is moderately large, subrhomboid, slightly alate, elongated, strongly inequilateral, solid anteriorly, thinner posteriorly, and compressed to somewhat inflated. The beaks are low, not inflated, and directed forward over a small lanule. They are marked with a few irregular ridges and small tubercles. The well-marked posterior ridge begins along the dorsal margin of the beaks, broadens somewhat and forms an angle where the posterior margin meets the ventral margin. A distinct depression, varying in depth, is found on the lateral slope just anterior to the posterior ridge. Immediately behind the posterior ridge the shell is swollen and in females greatly elongated. The surface of this swelling is marked with a series of six or more rough corrugations. These are small and closely spaced behind the umbones but increase in size and are more widely spaced as they extend downward. The dorsal margin is convex; the long ligament, which is dark brown to black, occupies the greater part of its length. The posterior margin differs distinctly between the two sexes: it is drawn out to a broad, elongated angle in females, and is abruptly truncate in males. A depression on the lateral slope just in front of the posterior ridge produces an indentation in the basal margin which is otherwise broadly rounded. The anterior margin is broadly convex. Almost the entire surface, especially that in front of the posterior ridge, is covered with tubercles. Upon the umbones the tubercles are small and granular, crowded, while below they become less crowded, lacrymiform or frequently chevronlike. In older specimens the lower third is generally unsculptured except

for densely crowded growth lines. The color varies from medium brown to black and apparently is not correlated with the age of the specimens.

There are two, large, triangular, radially sulcated pseudocardinals in the left valve and two long, straight, laterals of which the ventral is higher and sharper than the dorsal. There are two pseudocardinals in the right valve; the posterior large, triangular, and rough; the anterior much smaller. Sometimes there is a small tubercle upon the interdentum. The single lateral is long, straight, high, and rather strong. Anterior adductor scar, impressed, smooth in front, pitted posteriorly, is separated by a narrow, rounded ridge from the deeply impressed, triangular, anterior retractor scar. Posterior adductor scar is oval, shallow but distinct. The posterior adductor scar is indistinct but usually confluent with the posterior retractor scar. The beak cavities are shallow and irregularly pitted on their dorsal surface by the visceral muscle scars. The branchial ridge, which extends from the beak cavities to the anteroventral border of the posterior adductor scar, is narrow and distinct. The pallial line is distinct anteriorly, almost obsolete posteriorly. The shell is heavier in front. The nacre is white, and iridescent posteriorly.

Occurrence. Scammon reported *verruscosa* a common species in the Wakarusa and the collections at stations 6 and 7 indicate that the species has not suffered greatly from the ecological changes brought about in the stream during the last four decades. Here the species was practically confined to deep water and firm mud bottom.

General distribution. Mississippi drainage generally; streams flowing into the Gulf of Mexico from the Alabama system west to central Texas.

Length	Height	Diameter	
152 mm.	78 mm.	43 mm.	♀
122	69	42	♂
130	75	42	♀

Strophitus rugosus (Swainson) "Squaw Foot"

(Plate XXIX, Fig. 9, Cat. No. 908)

Baker, 1928, pp. 198-202.
Call, 1885, Vol. I, pp. 97, 122, 183; Vol. II, p. 18.
Scammon, 1906, pp. 322-323 (*edentulas*).
Simpson, 1914, pp. 349-351.

This shell is of moderate size, subovate, inequilateral, subsolid, and variably inflated, although never strongly. The beaks are moderate to full, somewhat elevated above the hinge line, directed inward and only slightly forward, and marked with a series of 3-4

heavy, subconcentric bars, which are turned up behind. The posterior ridge is variable; sometimes distinct, almost angular, sometimes low and rounded; in either case it ends in a rather broad angle on the post-basal margin. A second, or sometimes a third, low ridge may radiate from the beaks across the posterior slope. The dorsal margin is slightly convex; the posterior half is occupied by the heavy, dark brown ligament. The posterior margin is rounded obliquely downward to the angle formed by the posterior ridge. The ventral margin is slightly convex and continuous with the rather broadly rounded anterior margin; the latter terminates in front of the distinct lunule. The growth lines on the surface are variable, sometimes consisting of heavy ridges which alternate with a series of fine striations. The epidermis is generally smooth, but frequently becomes rough toward the periphery of the shell. Young specimens are a light olive green, faintly rayed; older specimens vary through golden brown, dark brown to black.

The pseudocardinals are almost wanting; however, a low, rounded ridge in the left valve on the hinge line just below the beak may be regarded as the vestigial pseudocardinal. In the right valve a similar ridge, along the hinge line, but usually in front of the beak, constitutes the vestige of the pseudocardinal. There are no laterals in either valve, although the shell is thickened along the hinge line. The anterior adductor scar is smooth, shallow, to deeply impressed behind. The anterior retractor scar is scarcely impressed; it may be confluent above with the anterior adductor scar. The posterior adductor scar is shallow, smooth, and confluent above with the much smaller retractor scar. The pallial line is remote and scarcely distinct. The beak cavities are shallow and devoid of cicatricial markings; the visceral muscles are inserted on the ventral surface of the rudimentrary pseudocardinal. The branchial line is low, rounded, and extends to the anteroventral border of the posterior adductor scar. The nacre may be bluish white, though this color is usually modified by rich infusions of cream or salmon. Iridescence is variable in different specimens, though in most shells more apparent near the periphery.

Occurrence. This species may be extinct in the Wakarusa river since only two dead shells were recovered.

General distribution. Mississippi drainage; Ohio west to Iowa, north to Michigan, south to Kansas.

Length	Height	Diameter
85 mm.	54 mm.	33 mm.

Anodonta grandis Say "Floater"

(Plate XXVIII, Fig. 2, Cat. No. 910)

Baker, 1928, pp. 152-155.
Call, 1885, Vol. I, pp. 97, 123, 183; Vol. II, p. 19.
Scammon, 1906, pp. 326-327.
Simpson, 1914, pp. 418-425.

The shell, moderate to large in size, is ovate to obovate, inequilateral, slightly alate, inflated, moderately thin, and gaps slightly anteriorly. The beaks are small, directed inward, strongly inflated laterally. They are sculptured with a small series of heavy, nodose, strongly double-looped ridges. The posterior ridge is low, rather indistinct, sometimes double and terminates at a rounded or biangulate point at the posteroventral margin. The dorsal margin is convex with a slight tendency toward alation posteriorly. The ligament is of moderate length and black in color. The posterior margin is obliquely truncate and meets the rounded ventral margin below the point formed by the posterior ridge. In females the ventral border is somewhat concave in front of the large marsupial swelling. The anterior margin is broadly rounded. The surface is marked by irregular, concentric ridges and fine striations. The latter predominate upon the beaks and just below them, giving the surface a varnished appearance; the later growth ridges are rough and coarse. A series of faint, delicately sculptured, branched and wrinkled lines extend radially from the beaks especially over the anterior and lateral slopes. The color varies from light olive green through dark brown to black; generally speaking, the color darkens with age, although not infrequently, young specimens are black. Infrequently younger specimens possess faint yellowish or greenish rays especially on the anterior slope. The escutcheon is nearly always stained with black.

There are neither pseudocardinals nor lateral teeth. The anterior adductor scars are large, smooth and shallow, confluent below with the small, almost indistinct retractor scar. The posterior adductor scar is of about the same size, smooth, shallow, confluent above with the smaller posterior retractor scar. The markings in the moderately shallow beak cavities consist of a few small visceral muscle scars in the dorsal angle and a rather distinct branchial ridge extending toward the ventral border of the posterior adductor scar. The pallial line is rather remote and generally indistinct. The color of the nacre, variable and seldom uniform, is white, or bluish-white, modified with shades of cream, salmon and rose, and generally overcast with an iridescence.

Occurrence. *Anodonta grandis* is one of the most widely distributed and prevalent forms in the Wakarusa, occurring at every locality at which mussels were found, although, never as abundant locally as *Proptera alata.* However, in spite of its tolerance of muddy conditions, *A. grandis* does not occur in the lower reaches of the stream which are heavily silted.

General distribution. Entire Mississippi system and upper St. Lawrence drainage; Red River of the North; Lake Winnipeg, Manitoba; southwest to Texas.

Length	Height	Diameter
148 mm.	70 mm.	53 mm.
140	79	56
143	80	54

Lasmigona complanata (Barnes) "White Heel Splitter"

(Plate XXIX, Fig. 13, Cat. No. 909)

Baker, 1928, pp. 147-151.
Call, 1885, Vol. I, pp. 96, 122, 183; Vol. II, p. 19.
Scammon, 1906, pp. 332-333.
Simpson, 1914, pp. 490-492.

The shell of this form is very large, one of the largest in Kansas. It is ovate, although the shape is frequently modified by a weak to strong alation. In young specimens the wing is high, while with age and wear it may almost completely disappear. The valves are solid anteriorly, and strongly inequilateral. The beaks are low, compressed, directed downward and forward over a very small lunule, and sculptured with a few, very heavy, double-looped ridges. The well-defined posterior ridge, which is often double, extends from behind the beaks to a broad angle on the posteroventral margin. The posterior slope above the posterior ridge is slightly concave to concave, is sculptured with a series of fine impressed lines which radiate from behind the beak, particularly in younger shells. A few subvertical, heavy, corrugations extend from above the posterior ridges toward or upon the wing. The dorsal margin is broadly convex, except that posteriorly it may be produced into a broad angle by the presence of a wing. The ligament is long, golden, or dark brown to black in color. The posterior margin is obliquely truncate above and almost perpendicularly truncated below. The ventral margin is broadly and regularly rounded and is continuous with the rounded anterior margin. The surface is sculptured with irregular, rather closely set, growth lines which tend to become rough, often plicate below. In addition, there are fine, irregularly spaced lines which radiate from the umbones over the lateral slope. They are almost

obsolete in older specimens. The epidermis is dark greenish-brown to black in color; faint green rays appear on younger shells. The surface has a smooth, somewhat shiny texture.

In the left valve are two large, triangular, roughly and deeply sulcated, pseudocardinals. The more posterior one is the larger, sometimes divided and extending as a ridge toward the single lateral upon which it frequently overlaps. The two pseudocardinals are separated by a deep, sometimes roughly pitted, depression. The lateral is irregular in height and length. Sometimes it is high and broad anteriorly, truncated behind but continuing as a low ridge, which may be rather faint for the length of the dorsal margin: sometimes its height decreases constantly toward the posterior termination. The right valve has one large and sometimes a second smaller, roughly sulcated, separated pseudocardinal. When two are present, the more posterior extends as a ridge to the single lateral. When only one is present, a short, concave interdentum separates the pseudocardinal from the lateral. The lateral of the right valve varies with the one of the left value. The anterior adductor scar is large, almost smooth, shallow in front but increasing rapidly in depth toward the pseudocardinals. It is convex in front, but the margin adjacent to the pseudocardinals is concave. A low, rounded ridge is frequently found extending from the pseudocardinals outward along the lower border of the scar; and sometimes impressed lines parallel this ridge above. This ridge is confluent with a low, rounded ridge which parallels the lower border of the adductor scar and separates it from the much smaller, lunate, somewhat impressed anterior retractor scar. The outline of the posterior adductor scar is similar to that of the anterior adductor scar except that it is much more elongate; it is confluent above with the small posterior retractor scar. The pallial line is remote, deep and distinct in front, but becomes almost obsolete near the posterior adductor scar. The beak cavities are shallow and contain anteriorly several long, sometimes deeply impressed visceral muscle scars. The lowest in this series sometimes extends outward toward the anterior adductor scar. The branchial impressions consist of one or more rounded ridges which extend from the beak cavities diagonally backward. The white nacre is tinted with blue or light salmon and becomes iridescent posteriorly.

Occurrence. The form is fairly wide spread in the Wakarusa and at stations 6 and 7 it was rather abundant in deep water where speci-

mens were found burrowing deeply in firm mud. Scammon reported it as common in the streams of the northeastern part of the state.

General distribution. Pennsylvania and Ohio to Iowa, Kansas and Arkansas, south to Alabama and north to Lake Winnipeg and Nelson river.

Length	Height	Diameter
168 mm.	100 mm.	56 mm.
162	101	45
145	102	50

Uniomerus tetralasmus (Say)

(Plate XXIX, Fig. 11, Cat. No. 911)

Call, 1885, Vol. I, pp. 96, 119; Vol II, p. 19.
Scammon, 1906, pp. 336-338.
Simpson, 1914, pp. 705-709.

This shell is of moderate size, subsolid, somewhat inflated, elongate, ellipsoid, and strongly inequilateral. The beaks are slightly elevated above the dorsal margin, directed downward and forward, and marked with a series of rather prominent, concentric ridges which are turned upward posteriorly. The posterior ridge, somewhat prominent anteriorly, becomes low and broad as it extends to the posteroventral margin. A narrower, sharper ridge parallels it above. The dorsal margin is straight to slightly convex; the posterior two-thirds is occupied by the dark brown to black ligament. The posterior margin, slightly truncate above, is otherwise rounded. The ventral margin is straight and parallel with the dorsal margin or slightly indented by the marsupial swelling below the posterior ridge. The anterior margin is rounded. The surface is marked with prominent and sometimes roughened growth lines which are paralleled by finer striations giving the shell a glossy appearance. Intricately and finely branched lines of submicroscopic dimensions radiate from the beaks especially along the anterior and the lateral slopes. The color varies through dull yellow, light brown to seal brown. The posterior slope is usually darker than the general color of the shell and dark bands parallel especially the later growth lines.

In the left valve are two, low, compressed, triangular, serrated, pseudocardinals. The anterior is large and heavy, sometimes almost pyramidal, the tip reflected forward. The posterior is smaller, lower, and occupies a position parallel with the hinge line. Occasionally the posterior tooth is almost wanting. There are two, thin, sharp, elongate, slightly curved laterals which terminate very obliquely. They are separated by a very narrow groove. In the right valve the posterior pseudocardinal is heavy, compressed-triangular, serrated, and bent downward. The anterior pseudocardinal is weak or want-

ing. The anterior adductor scar is broadly convex in front, smooth and shallow except posteriorly where it is deeply impressed; the posterior margin is very irregular. A narrow, irregular ridge separates the adductor scar below from the impressed anterior retractor scar which is fully one-third as large as the former. The posterior adductor scar is round to obovate, smooth, scarcely impressed, and confluent above with the posterior retractor scar which is much smaller than the anterior retractor scar. The beak cavities are shallow, somewhat pitted above by the visceral muscle scars. The branchial ridge is low, narrow and rounded and extends obliquely backward to the anteroventral border of the posterior adductor scar. The color is white or bluish-white, sometimes suffused with cream and somewhat iridescent posteriorly.

Occurrence. This is one of the few species which Scammon specifically reported from the Wakarusa. At present it seems to be widely distributed in this stream, although not abundant in any particular locality. It is widely distributed in Kansas and is common even in the small, muddy, streams of the western part of the state.

General distribution. Mississippi valley as far north as 40° N. latitude and southwest to México. It is also found in Ohio and Alabama river systems.

Length	Height	Diameter
82 mm.	40 mm.	26 mm.
73	36	24
60	32	20

Amblema costata (Rafinesque) "Three-Ridge"

(Plate XXIX, Fig. 14, Cat. No. 906)

Baker, 1928, pp. 80-83.
Call, 1885, Vol. I, pp. 96, 122, 183; Vol. II, p. 23.
Scammon, 1906, pp. 344-346.
Simpson, 1914, pp. 819-822.

The rhomboidal, very strongly inequilateral, slightly alate, subinflated, shell is solid anteriorly, subsolid posteriorly. The slightly elevated beaks are directed forward over a small lunule, and are sculptured with a few distinct ridges which are turned up behind, and more evident on an immature than on an older and worn shell. The broad, rounded, posterior ridge is ill defined. The long, straight or slightly rounded dorsal margin meets the posterior margin at a broad angle. The ligament is long, dark brown to black. The posterior margin slopes obliquely backward and downward and is truncated below by the broad rounded point formed by the termination

of the posterior ridge. The rounded ventral margin is continuous in front with the broadly rounded anterior margin. Rounded ridges radiate from the outer margin of the beak to the ventral and the posterior margins; on the posterior slope these ridges curve upward, while on the lateral slope they extend obliquely downward. Scattered, low, elongated pustules are frequently present on the posterior half of the valves. Young shells are covered with a yellow to dull-green periostracum which becomes dark brown to black in older shells.

In the left valve, the two large, elevated, triangular, pseudocardinals are radially sulcated. In the right valve a large, subtriangular, sulcated pseudocardinal is separated by a deep groove from a smaller, divergent ridge in front. The long, almost straight laterals are two in number in the left valve and one in the right valve. The interdentum is short, broad, and heavy. The deeply impressed lunate, anterior adductor muscle scar extends upward to the hinge line, and is roughened; an irregular, prominent ridge separates this scar from the deeply impressed, but much smaller, obovate anterior retractor scar. The posterior scar is wide, distinct, smooth, and not impressed, and confluent above with the much smaller posterior retractor scar. Anteriorly the pallial line is deeply impressed, but becomes fainter posteriorly. The branchial line consists of a narrow depression extending from the beak cavities to the ventral border of the anterior adductor scar. In the anterior part of the shell the polished nacre is white to slightly iridescent. Dorsally and posteriorly, the iridescence intensifies to a rich metalic sheen.

Occurrence. This species is very abundant especially at stations 6 and 7 where it was found burrowing in firm mud in rather deep waters in company with *Lasmagonia complanata, Proptera alata, Tritogonia verruscosa, Quadrula quadrula,* and *Quadrula pustulosa.* It was less abundant, but not uncommon on gravel and sandy shoals.

General distribution. Mississippi basin generally; St. Lawrence drainage; Red River of the North; Lake Winnipeg, Alabama river system. Its distribution in the south is, according to Baker, not well known.

Length	Height	Diameter	
122 mm.	76 mm.	51 mm.	♂
118	68	43	♂
113	70	56	♀

Quadruala quadrula (Rafinesque) "Maple Leaf"

(Plate XXVIII, Fig. 8, Cat. No. 903)

Baker, 1928, pp. 84-87.
Call, 1885, Vol. I, pp. 96, 181; Vol. II, p. 21.
Scammon, 1906, pp. 351-352.
Simpson, 1914, pp. 841-842.

The subrhomboid, inequilateral, somewhat inflated shell is solid, but appreciably thicker in front. The prominent beaks, forwardly directed over a small lunule, are sculptured with double-looped ridges and irregular tubercles and granules. The prominent posterior ridge begins narrowly at the dorsal tip of the umbone and spreads widely to the lower extremity of the posterior margin. It is frequently paralleled above by an inferior elevation. Immediately anterior to the posterior ridge a depression begins narrowly above the beak and widens rapidly as it extends downward across the lateral slope. The dorsal margin is straight or slightly convex. The ligament, black in color, extends along the dorsal margin from the beak to the posterior margin. The ventral margin, which is arcuated by the wide depression in front of the posterior ridge, continues anteriorly with the broadly rounded anterior margin. The surface of the shell is marked by coarse, irregularly spaced growth lines which are darkly colored along the outer edges, and with a number of tubercles. These rather small, lacrymiform, or elongated tubercles are arranged in three series; those of the group in the depression along the posterior margin are low; those along the posterior ridge are somewhat heavier; while those on the more anterior elevation are very heavy and become horizontally elongated especially toward the ventral margin. The tubercles, low and crowded on the umbo, become larger and less numerous toward the ventral margin. Frequently there is a small series of low tubercles in the wide depression. The periostracum is somewhat glossy. The color, dull olive green in younger specimens, tends toward a dark green to dark brown with increase in age of the animal.

In the left valve, the two pseudocardinals are heavy, triangular, sulcated, and roughened. The two laterals are straight. The ventral tooth is about twice as high as the dorsal. The interdentum is short and heavy. In the right valve the single pseudocardinal is triangular, deeply and radially sulcated, and preceded by a small divergent ridge. The single lateral is high and straight. The anterior adductor muscle scars are deep and smooth except for a series of overlying, low, ridges in the posterior ventral portion. They are placed immediately anteriorly to the pseudocardinals and separated

ventrally by a rounded ridge from the much smaller, deeply impressed and confluent retractor scars. A series of small deep but compressed visceral scars perforate the anterior surface of the beak cavity. The branchial ridge is low, subvertical, and extends from the posterior margin of the beak cavity to the anterior margin of the posterior adductor scar. The pallial line is more prominent anteriorly than posteriorly where it is almost obscured. The white, glossy, nacre is slightly iridescent anteriorly, and very much so posteriorly.

Occurrence. Many fine examples of this species were found in the Wakarusa river where it is widely distributed and locally abundant at stations 6 and 7. It apparently prefers a firm mud bed in deep flowing water.

General distribution. Entire Mississippi drainage; various localities in St. Lawrence basin; Red River of the North; southwest and eastern Texas.

Length	Height	Diameter
111 mm.	88 mm.	53 mm.
97	74	49
92	74	45

Quadrula pustulosa (Lea) "Pimple Back"

(Plate XXVIII, Fig. 5, Cat. No. 902)

Baker, 1928, pp. 90-93.
Call, 1885, Vol. I, pp. 96, 121, 182; Vol. II, p. 22.
Scammon, 1906, pp. 354-356.
Simps n, 1914, pp. 848-852.

The shell is subrhomboid, suborbicular, inequilateral, inflated, and solid. The beaks are high, somewhat inflated, turned forward over a small lunule, and sculptured with a few ridges which in local specimens tend to be worn away. The beaks are rounded in front, sometimes angulate behind. The posterior ridge is moderately high and frequently paralleled above by an inferior elevation. The dorsal, rounded, margin is convex, meeting the truncated posterior margin at a rounded angle. The stout, dark brown to black ligament extends along the posterior two-thirds of the hinge line. The ventral margin is straight in front of the posterior ridge and rounds upward anteriorly where it is continuous with the rounded anterior margin. The posterior slope is slightly concave. The surface is marked with scattered pustules which vary in size. They are sometimes elongated parallel with the growth lines, sometimes lacrymiform. Local specimens are frequently almost smooth and all are much less pustulose than typical forms of this species. Fine growth lines appear on the yellowish-green periostracum: the rest periods are outlined in dark lines. The color varies through deep tan to brown.

There are two, heavy, triangular, roughened, pseudocardinals in the left valve separated by a short, heavy, interdentum from the two curved laterals. The ventral lateral tooth is somewhat higher and sharper than the dorsal. The right valve contains a single, heavy, roughened, broadly triangular, pseudocardinal sometimes flanked both anteriorly and posteriorly by a small denticle.

The anterior adductor muscle scar is deeply impressed, smooth except posteriorly where it is very deeply pitted. Ventrally a very narrow ridge separates this scar from the deeply impressed, lunate anterior retractor scar. The posterior muscle scar is slightly impressed, about twice the size of the anterior adductor scar, smooth and almost always confluent with the posterior retractor muscle scar. The beak cavities are deep, somewhat compressed; the anterior margin is marked by the relatively coarse, irregularly distributed visceral muscle scars. The pallial line is relatively remote, more deeply impressed anteriorly, but distinct throughout. The branchial ridge, very broad in the beak cavities, extends diagonally backward below the posterior adductor scar to the pallial line. The shell is distinctly thicker anteriorly. The nacre is a pearly white, becoming iridescent posteriorly.

Occurrence. *Quadrula pustulosa* is locally common though not widely distributed in the Wakarusa river. At the stations where it was found, it differed from *Q. quadrula* by inhabiting shallower waters, and sandy and gravelly bottoms, although, occasional specimens were found in the deep waters along with *Q. quadrula.*

General distribution. Entire Mississippi drainage; Michigan; Lake Erie.

Length	Height	Diameter
66 mm.	59 mm.	41 mm.
70	58	39
65	58	38

Fusconaia flava (Lea) "Wabash Pig-Toe"

(Plate XXIX, Fig. 15, Cat. No. 905)

Baker, 1928, pp. 53-57.
Call, 1885, Vol. I, pp. 96, 182; Vol. II, p. 22.
Scammon, 1906, pp. 359-360.
Simpson, 1914, pp. 872-873.

This obovate shell is subsolid, thickest anteriorly, only slightly inflated, and inequilateral. The beaks are high, full, directed forward and sculptured with a series of ridges which are low anteriorly, heavier posteriorly where they are drawn up to a sharp angle along the posterior ridge. The subangular, rather prominent, posterior ridge begins narrowly along the posterior margin of the beaks, and

broadens considerably to the lower extremity of the posterior margin where it terminates in a slight angulation. It is sometimes paralleled above by a lower and much narrower ridge. The dorsal margin is straight and long. The heavy, black ligament occupies the posterior two-thirds of the dorsal margin. The posterior margin is obliquely truncated. The rounded basal margin is sometimes slightly arcuated just anteriorly to the posterior ridge. The anterior margin is rounded and often slopingly truncated above, meeting the dorsal margin at an angle. The surface of the shell is free from tubercles or pustules. Between the widely separated, heavy, growth lines marking periods of rest, are fine striations giving the shell a silky surface. The periostracum of the younger shell is a dark golden brown while that of the older specimens deepens to a dark brown.

In the left valve, the two pseudocardinals are high, triangular, and deeply serrated. The two laterals are long and straight or almost so. The ventral lateral is somewhat higher than the dorsal. The interdentum is short, narrow, and rather heavy. In the right valve, the single pseudocardinal is high and serrated. It is frequently preceded by a small divergent ridge. The anterior adductor muscle scar is smooth and shallow anteriorly, deep and rough just in front of the pseudocardinal, and separated below by a low ridge from the small, smooth, distinct retractor muscle scar. The posterior adductor muscle scar is distinct, smooth and shallow. Just below the termination of the lateral, is located the small, smooth, distinct posterior retractor muscle scar, usually confluent above with the posterior adductor scar. Several groups of small, deep scars of the visceral muscle insertions perforate the anterior surface of the beak cavity below the pseudocardinals. The branchial ridge is broad and rounded and terminates below the posterior adductor scar. The pallial line, removed from the margin, is very prominent anteriorly and diminishes posteriorly. The white, polished nacre becomes somewhat iridescent posteriorly.

Occurrence. *Fusconaia flava* does not occur in large numbers in the Wakarusa, although, it is more widespread in its distribution than species of relatively great abundance. It was taken in fair numbers in station No. 6.

General distribution. Western New York west to Kansas and Nebraska and from the Red river of the North south to Kentucky and Western Virginia.

NAIAD SPECIES	ST.1 – 6 MI. W. 1/2 MI. S. OF AUBURN	ST.2 – 1/2 MI. S. OF AUBURN	ST.3 – 3 MI. E. OF WAKARUSA	ST.4 – 6 MI. E. OF WAKARUSA	ST.5 – 1 1/2 MI. E. OF BELVOIR	ST.6 – 1 1/2 MI. E. OF CLINTON	ST.7 – 4 MI. E., 1 MI. N. OF CLINTON
	STATIONS AND OCCURRENCE OF SPECIES						
TRUNCILLA DONACIFORMIS							O
LAMPSILIS SILIQUOIDEA			O			O	
LAMPSILIS ANODONTOIDES		O		O	O	O	O
LIGUMIA SUBROSTRATA			O		O	O	
CARUNCULINA PARVA		O	O	O			
PROPTERA ALATA	O					O	O
LEPTODEA FRAGILIS						O	
TRITOGONIA VERRUCOSA						O	O
STROPHITUS RUGOSUS						O	
ANODONTA GRANDIS		O	O	O	O	O	O
LASMIGONA COMPLANATA		O		O		O	O
UNIOMERUS TETRALASMUS		O	O	O	O		
AMBLEMA COSTATA						O	O
QUADRULA QUADRULA			O		O	O	O
QUADRULA PUSTULOSA						O	O
FUSCONAIA FLAVA		O	O			O	O

TEXT FIG. 4. Distribution of naiad species in the Wakarusa river.

Length	Height	Diameter
80 mm.	56 mm.	33 mm.
72	52	30
63	47	26

GASTROPODA

INTRODUCTION

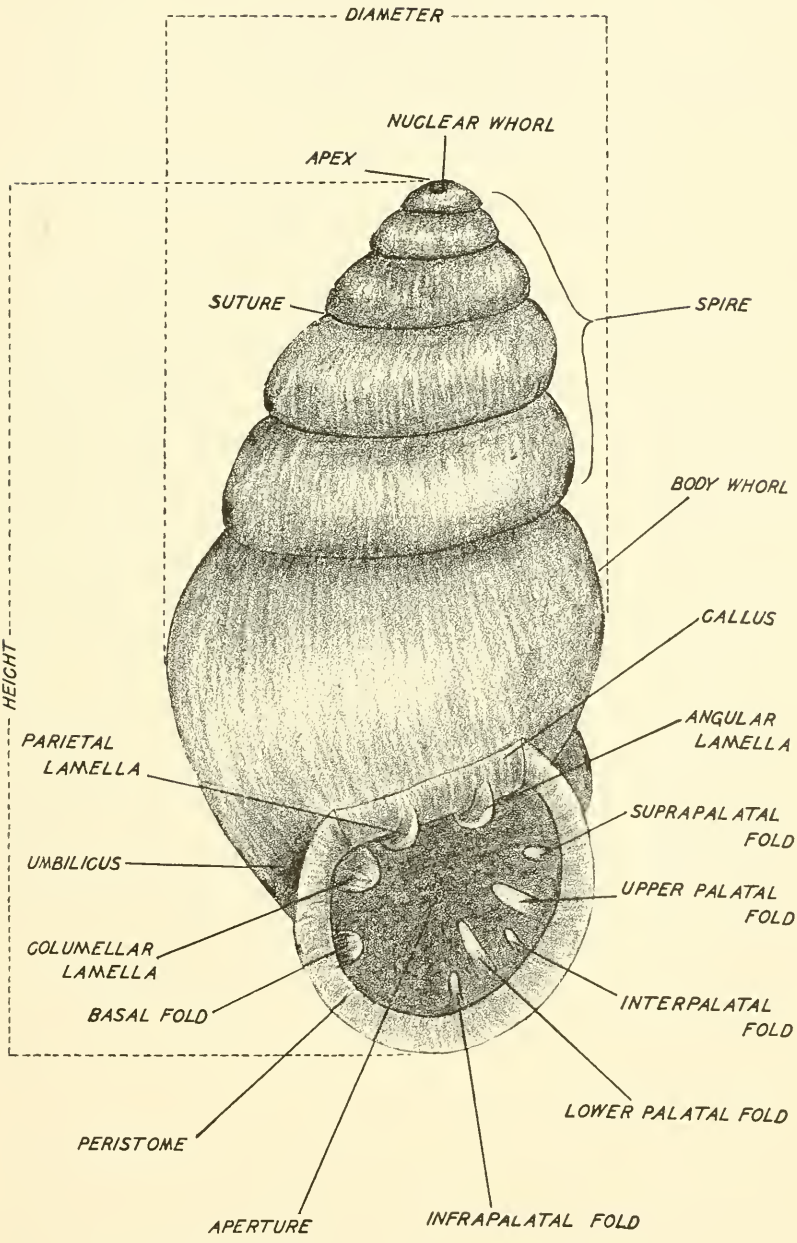
Gastropods were collected from a series of 10 collecting stations located along the Wakarusa river itself or along the near-by timbered areas. Two stations are exceptions to this, Blue Mound (station No. 9), which is perhaps a half mile from the stream, and station No. 8, which includes the various roadside pools of the lower valley.

There are no specialized methods particularly applicable to the collection of snails. Terrestrial forms live in a variety of habitats, under logs, among dead leaves, at the bases of stumps, under started bark, or in deep grass, or even in the soil; aquatic forms are easier to find, and one may more often find them crawling about. Care was taken to keep collections from a specific locality in a properly labeled container separate from all others; even this is perhaps not enough; no doubt, there is a need for more specific ecological data, which can be acquired only by keeping very minute records on types of habitat.

When the shells were wanted for study or for cataloguing, the live animals were dropped in boiling water and removed after a few moments. The bodies are removed easily after such treatment and the shell is clean. When preserved specimens were needed, the animals were drowned by placing them in a closely covered container of water. They die extended and can then be preserved in alcohol.

After sorting and identification, suitable series of shells were selected, assigned a number and placed in the cabinets of the molluscan collection of the Natural History Museum of the University of Kansas.

The scant literature on the gastropods of Kansas was reviewed by Franzen and Leonard (1942).



TEXT FIG. 5. Diagram of named parts of gastropod shell.

DESCRIPTION OF SPECIES

Subclass STREPTONEURA

ORDER CTENOBRANCHIATA

SUBORDER PLATYPODA

FAMILY VIVIPARIDAE

GENUS *Campeloma* Rafinesque

Campeloma subsolidum Anthony

(Plate XXX, Fig. 9, Cat. No. 917)

Baker, 1902, pp. 361-362.

The operculate shell of *Campeloma subsolidum* is elongate spiral, very heavy, the epidermis shining and yellowish-green to olive-green, the surface embellished with vertical growth lines which on the base are gathered into heavy wrinkles. There are 6-7 whorls, the first elevated and tightly coiled, the body whorl large, inflated, and occupying two-thirds of the total length. The suture is deeply impressed, the whorls perceptibly flattened and shouldered below the suture. The aperture is oval, narrow above, broadly rounded below, the lip simple, reflected over the umbilicus, and the terminations connected over the body whorl by a heavy, white, callus. Beneath the epidermis the shell is likewise chalky to translucent white.

Occurrence. *Campeloma subsolidum* lives in soft mud along the banks of the streams in which it often burrows. Although, Hanna (1909) reported both *C. subsolidum* and *C. decisum* to be common in the Wakarusa, only two dead shells were found in this collection, and it would appear that *Campeloma* is now extinct in this stream.

Height	Greater Diameter	Lesser Diameter
30 mm.	21 mm.	17 mm.

Subclass EUTHYNEURA

ORDER PULMONATA

SUBORDER BASOMMATOPHORA

FAMILY LYMNAEIDAE

GENUS *Lymnaea* Lamarck

Lymnaea bulimoides techella (Haldeman)

(Plate XXX, Fig. 5, Cat. No. 918)

Baker, 1911, pp. 215-217.

This snail, found in populous colonies in roadside and other pools, is not large, about one-half inch long, with a sharply conic spire which occupies not more than one-third of the total length. The 5 whorls of the spire are flattened, somewhat shouldered, separated by a rather deeply impressed suture; the surface striate, or almost granular above. The surface of the body whorl is coarsely striate with both vertical and spiral ridges which gives the surface a malleated appearance. The body whorl is convex and inflated, narrowing somewhat toward the aperture which is oval. The lip is rather thin, simple, somewhat sinuous along its inner border where it is reflected over the partly covered, round, deep, umbilicus. A callus across the parietal wall connects the terminations of the lip. The color is buff to light brown with opaque, whitish streaks across the body whorl; the shell is not heavy, the surface texture, dull.

Occurrence. *Lymnaea bulimoides techella* is locally abundant in roadside ditches, such as those of station 8, throughout the broad terraces of the lower Wakarusa valley. It may be found in ephemeral pools where it appears in large numbers for a few weeks in the early spring. Many of the adults die after the egg laying period and few adults are seen through the hot summer months; immature individuals presumably remain alive, buried in the mud.

Height	Greater Diameter	Lesser Diameter
13 mm.	9 mm.	7 mm.
12	7	6
11	6	5

Lymnaea parva Lea

(Plate XXX, Fig. 6, Cat. No. 919)

Baker, 1911, pp. 243-248.

Lymnaea parva is a small snail, the shell of which is characterized by 5 turreted whorls separated by a deep suture. The body whorl is strongly inflated and the height of the oval aperture comprises no more than one third of the total length. The periostracum is yellowish to light brown, somewhat shining with subvertical, fine, irregularly spaced, growth lines. The peristome is thin and sharp, its terminations almost continuous and connected by a callus over the parietal wall, its inner border reflected, partly covering the small umbilical chink.

Occurrence. *Lymnaea parva, like L. dalli*, and one or two other small species of *Lymnaea*, is scarcely ever found in the water, although, it does require a rather moist habitat. It may be found crawling on vegetation or upon the ground in marshy areas, or it seems to thrive in piles of moist drift. Local specimens were taken from such a situation, station No. 1.

Height	Greater Diameter	Lesser Diameter
4.9 mm.	2.7 mm.	2.2 mm.
4.8	2.5	2.0

Lymnaea obrussa Say

(Plate XXX, Fig. 7, Cat. No. 920)

Baker, 1911, pp. 270-283.

The shell of *Lymnaea obrussa* has an elongate, conic form; there are 5-5½, strongly convex whorls somewhat shouldered above; the spire is almost equal to half the total length and the aperture is surrounded by a thin, simple lip which on its inner border is reflected over the partly covered umbilicus. Closely spaced, fairly regular, vertical growth lines decorate the light yellowish shell, the surface of which is dull to somewhat shining. According to Baker (op. cit., p. 275) the size of this species is subject to considerable variation, the total length ranging up to three fourths inch. The single specimen taken from drift at station No. 1 is slightly over one-fourth inch in length.

Occurrence. Hanna (1909) reported a large colony of this species in a watercress spring west of Lawrence, but *Lymnaea obrussa* is represented in these collections by a single drift specimen taken near the head waters of the Wakarusa.

Height	Greater Diameter	Lesser Diameter
7.3 mm.	3.6 mm.	3.1 mm.

FAMILY ELLOBIIDAE

GENUS *Carychium* Müller

Carychium exile H. C. Lea

(Plate XXX, Figs. 3, 4; Cat. No. 948)

Baker, 1939, p. 136.

Carychium exile, the smallest snail in the Wakarusa valley, never exceeding a length of one-twelfth inch, is yellowish-white, with a waxy texture. The fusiform shell has about 6 convex whorls separated by a well-impressed suture. The height of the body whorl is about equal to that of the spire. The aperture is laterally compressed; the peristome thickened and expanded. The surface is finely sculptured with obliquely vertical growth lines. Within the parietal angle of the peristome appears the termination of the columellar lamella which winds upward around the columella as a widely expanded fold which is bent downward to form one of the most characteristic features of the shell (Plate VI, Fig. 4).

Occurrence. A small series of shells of this species was taken from drift at station No. 1. This form is said to inhabit moist soil near streams, but because of its almost microscopic size it is easily overlooked; through appropriate and intensive collecting methods it might be found to be more widely distributed.

Height	Diameter
1.8 mm.	.6 mm.
1.6	.5

FAMILY PLANORBIDAE

GENUS *Helisoma* Swainson

Helisoma trivolvis (Say)

(Plate XXX, Fig. 2, Cat. No. 921)

Baker, 1928, pp. 330-334.

The shells of *Helisoma trivolvis* are discoidal and sinistral, that is, the aperture opens toward the left. The whorls of the spire coil in a plane or the spire may be slightly concave. The body whorl, much larger, is sometimes carinate above, but all the whorls are rounded below. The aperture is irregularly lunate, the lip simple and sharp, the two ends approaching, and connected by a callus across the parietal surface. These reddish-brown shells, which locally vary up to an inch in diameter, are sculptured with distinct, closely set transverse lines which are apparent without magnification. This common snail is easily recognized by its discoidal shape and flat spire.

Occurrence. *Helisoma trivolvis* is sparingly distributed throughout the Wakarusa, but is most frequently encountered in ponds and roadside pools such as those of station No. 8, where it may be abundant.

Height	Greater Diameter	Lesser Diameter
8 mm.	20 mm.	13 mm.
8	19	13

FAMILY PHYSIDAE

GENUS *Physa* Draparnaud

Physa hawni Lea

(Plate XXX, Fig. 11, Cat. No. 922)

Baker, 1928, pp. 449-453.

The imperforate shells of *Physa* are sinistral, that is, the aperture opens at the left side of the columella. In *P. hawni* there are 5 whorls, those of the spire somewhat convex, separated by a rather shallow suture, the spire thus forming an acute cone. The body whorl is greatly swollen, large, occupying three-fourths or more of the total length. The aperture is elongate, oval; the lip thin and simple, the terminations connected by a prominent callus across the parietal wall; the inner termination is characterized by a columellar plait. There are fine, irregular vertical striations on the surface, and exceedingly fine spiral lines which cross these, giving the surface a glossy texture; the color is a light brown, often with reddish streaks along the scars produced at rest periods. A reddish-brown stripe within the aperture parallels the outer margin of the peristome.

Occurrence. Common in roadside pools in colonies of considerable size. Much less common than *Physa anatina* in streams, although Lea described it from "Verdegris river, Kansas."

Height	Greater Diameter	Lesser Diameter
20 mm.	10 mm.	9 mm.
19	12	10
19	11	9

Physa anatina Lea

(Plate XXX, Fig. 10, Cat. No. 923)

The shell of *Physa anatina* may be distinguised from *P. hawni* by its shorter spire, flatter whorls of the spire, very shallow suture, narrower aperture, and generally speaking, by its glossier texture. The spire occupies no more than one-ninth of the total length, while the spire of *P. hawni* is equal to at least one-fifth of the height. The lateral lip of *P. hawni* is exserted above, while this is not the case

in *anatina*. The sculptured lines of *P. anatina* tend to be finer, giving the shell a glossier, silkier, texture. The color is tan to light brown. A reddish streak, often on a whitish callus, parallels the border of the peristome in many individuals; it is a variable and an inconstant feature, and is of little value as a recognition character. A broad callus, sometimes so thin as to be scarcely discernible, connects the terminations of the thin, simple lip. The columellar plait is similar to that found in *P. hawni*.

Occurrence. *Physa anatina* is widely distributed throughout the Wakarusa valley in ponds and roadside pools. It is much more common than *P. hawni* in small tributary streams.

Height	Greater Diameter	Lesser Diameter
14 mm.	9 mm.	7 mm.
12	8	7
11	8	6

TERRESTRIAL FORMS

SUBORDER STYLOMMATOPHORA

FAMILY POLYGYRIDAE

GENUS *Triodopsis* Rafinesque

Triodopsis albolabris alleni ('Wetherby' Sampson)

(Plate XXXI, Figs. 13, 17; Cat. No. 924)

Baker, 1939, p. 49.
Pilsbry, 1940, pp. 835-842.

Triodopsis albolabris alleni is one of the largest of the snails of this region. The honey-yellow shell is composed of 5-5½ whorls, the suture well impressed, the spire rather depressed. The body whorl enlarges rapidly, terminating in an oblique aperture which is bordered by a broad, white, reflected lip, which gives the species its name. The lip completely seals the umbilicus. The surface is embellished with closely spaced transverse striations, and numerous fine, impressed lines, visible only after magnification, parallel the suture. These lines are bent downward as they cross the transverse striations, giving them an undulating course, a feature which serves to distinguish this form from *Mesodon zaletus*.

Occurrence. This attractive snail, nowhere common in this region, prefers deep, undisturbed woodlands, a condition which does not prevail widely in the Wakarusa valley. However, occasional specimens may be found crawling about on the vegetation in moist, shaded woods.

Height	Greater Diameter	Lesser Diameter
14 mm.	24 mm.	20 mm.
15	25	21
16	27	22

GENUS *Stenotrema* Rafinesque

Stenotrema fraternum fraternum (Say)

(Plate XXXI, Fig. 18, Cat. No. 925)

Baker, 1939, p. 61.
Pilsbry, 1940, pp. 681-684.

The shell of *Stenotrema fraternum fraternum* is heliciform, the whorls rather tightly coiled, about 6 in number; the spire is shortly conoid, the base convex but impressed around the almost covered umbilicus. The convex whorls are covered with fine, obliquely vertical striations; they are wound tightly around the axis, but increase steadily in size toward the obliquely lunate aperture. The thin, white lip is reflected outward and at its inner termination almost covers the umbilicus. A white, slightly sinuous, denticle lies partly within the peristome, and frequently extends as a low callus toward the axis. The light brown shell is covered with hairlike epidermal growth which is especially conspicuous on young shells; on older specimens or on dead shells these "hairs" are usually worn away leaving tiny pits on the surface. Many of the specimens from this valley resemble the form described as *S. monodon alicea* from which *S. f. fraternum* is said to differ by its larger size and noticeably wider whorls. However, the examples which are seemingly identical with *S. m. alicea* occur in colonies of typical *S. f. fraternum;* moreover, it is possible even in a small collection to arrange the shells in a series grading from *S. m. alicea* to *S. f. fraternum.* Pilsbry (1940, p. 681) says, "it must be admitted that some of the larger forms of *S. m. alicea* can be separated from *S. f. fraternum* with difficulty. There is no definite distinction." Since the two forms are found together within a restricted locality, it would not appear that they are ecological variations.

Occurrence. Stenotrema fraternum fraternum is distinctly a woodland snail, and thrives best in leaves, or near old stumps or logs among trees. It can be found in fair numbers throughout the Wakarusa valley where such conditions prevail. It cannot be said to be colonial in habit, though a number of individuals may be found within a small area if conditions be favorable.

Height	Greater Diameter	Lesser Diameter
5 mm.	8 mm.	7 mm.
5	8	7
5.5	9	8

FAMILY ZONITIDAE

GENUS *Retinella* (Shuttleworth) Fischer

Retinella electrina (Gould)

(Plate XXXI, Fig. 12, Cat. No. 926)

Baker, 1939, pp. 69-70.

The perforate shells of *Retinella electrina* are small, yellowish, about one fifth inch in diameter, heliciform, with depressed spire and rounded base which is indented toward the small, round, umbilicus in which all the whorls may be seen. The suture is distinct but shallow; whorls 4 in number, the last increasing rapidly toward the oval aperture; the peristome thin, its upper margin high on the body whorl, its lower margin recurved. The surface is smooth, vitreous, but sculptured with rather closely spaced indented lines which are scarcely visible without magnification. In the whorls of the spire these indented lines extend across the suture.

Occurrence. *Retinella electrina* is widely distributed over this area and may be found in woodlands, under bark, fallen branches, and other debris. Its distribution parallels that of *R. indentata* rather closely, although, it is not quite so commonly encountered.

Height	Greater Diameter	Lesser Diameter
2.7 mm.	4.9 mm.	4.0
2.3	4.9	4.0
2.3	4.6	3.9

Retinella indentata (Say)

(Plate XXXI, Fig. 14, Cat. No. 927)

Baker, 1939, p. 71.

The scarcely perforate shells of *Retinella indentata* are small, about one-fifth inch in diameter, translucent, yellowish, and heliciform with depressed spire. The surface is smooth and glossy with widely-spaced, impressed, radiating lines. The suture is distinct but shallow, whorls four. The body whorl increases rapidly toward the rounded lunate aperture. The lip of the peristome is thin, its upper margin high on the body whorl, the basal margin terminating near the small umbilicus over which it is partly reflected, reducing the opening to a minute perforation. The base is only slightly convex and somewhat indented near the umbilicus.

Occurrence. The species is widely distributed in the Wakarusa valley, in wooded ravines and along the banks of the streams wherever trees and shrubs afford cover. It is frequently encountered

under started bark, old logs, and among dead leaves. It is closely associated with *Zonitoides arboreus* and *Retinella electrina.*

Height	Greater Diameter	Lesser Diameter
2.4 mm.	5.2 mm.	4.6 mm.
2.7	4.5	4.1
2	4.1	3.6

GENUS *Hawaiia* Gude

Hawaiia miniscula (Binney)

(Plate XXXI, Figs. 20, 21; Cat. No. 928)

Baker, 1939, p. 72.

The shell of this species is small, with a depressed to slightly elevated spire and a rounded periphery. The shell is hyaline to white, closely marked with fine growth lines, which give the surface a silky to glossy appearance. The four, convex, tightly coiled whorls, separated by a well impressed suture increase slowly and steadily in size from the embryonic whorl to the body whorl which does not become inflated toward the aperture. The transverse, rounded, aperture is bordered by a sharp edged peristome. The ends of the lip are turned inward, but are not continuous over the body whorl. The umbilicus is broadly open, and all the whorls may be seen within it.

Occurrence. Hawaiia miniscula is a common snail in the Wakarusa valley, where it lives in rocky ledges or among dead leaves and under fallen logs. It thrives in piles of moist drift where it has been cast by flood waters. This little snail may be recognized by its small size, and wide, shallow umbilicus.

Height	Greater Diameter	Lesser Diameter
1.2 mm.	2.4 mm.	2.2 mm.
1.0	2.1	1.9
1.0	2.0	1.9

GENUS *Euconulus* Reinhardt

Euconulus chersinus cf. *polygyratus* (Pilsbry)

(Plate XXXI, Fig. 16, Cat. No. 929)

Baker, 1939, p. 79.
Goodrich, 1932, p. 31.

Shells of this genus are small, conical, scarcely over 3 or 4 mm. in height; the whorls tightly coiled, the shell thin and smooth with a soft silky texture, and light amber in color. From shell characters alone the small series of local forms seems referable to *Euconulus chersinus polygyratus* since there are 6 whorls, the spire is low and convex, the body whorl rounded at the periphery, and the outer lip

of the peristome slightly above the middle of the last whorl, giving the aperture a compressed lunate outline. The small umbilicus which is included 8 or 9 times in the diameter of the base, is partly covered by the lip which is here somewhat reflected, but elsewhere thin, sharp, and simple. The base is convex but slightly indented around the umbilicus. However, the radular formula of examples collected is characteristic of *E. fulvus* (Pilsbry, 1899) which leaves the identity of these forms in doubt. Additional studies are needed in order to arrive at a definite conclusion.

Occurrence. A single drift specimen was taken at station No. 1, and a small series of immature examples was taken on the north slope of Blue Mound (station No. 9) in moist, deep, leaf mold under logs in an oak-hickory association.

Height	Greater Diameter	Lesser Diameter
1.9 mm.	2.7 mm.	2.4 mm.
2.1	2.7	2.6
2.4	2.9	2.7

GENUS *Zonitoides* Lehman

Zonitoides arboreus (Say)

(Plate XXXI, Fig. 15, Cat. No. 930)

Baker, 1939, pp. 78-79.
Baker, 1902, pp. 187-189.

This snail bears a superficial resemblance to some of the species of *Retinella*. It is scarcely one-fourth inch in diameter, depressed heliciform, and yellowish-amber in color. The suture is well impressed, the whorls about 5, the last increasing in size somewhat as it nears the rounded, lunate, aperture. The lip is thin and simple; the outer border is above the periphery of the body whorl, the inner near the umbilicus and turned upward somewhat. The umbilicus is round and deep, the convex base indented near it. The upper surface of the shell is covered with crowded, irregularly spaced, growth lines; the base is smoother.

Occurrence. Very common in woods, even in isolated patches of timber or native shrubbery, where it lives in old wood, under started bark, under decaying logs, and among dead leaves and other forest debris.

The three commonly associated species, *Retinella indentata, R. electrina,* and *Zonitoides arboreus*, may be confused unless carefully observed. The two species of *Retinella*, however, have four whorls, the suture is less impressed, the surface smoother and more glossy than that of *Z. arboreus*. *R. indentata,* moreover, may be distin-

guished by its imperforate or almost imperforate umbilicus, and by the widely spaced, indented surface lines. *R. electrina* has the open umbilicus like *Z. arboreus,* but the smaller number of whorls (four), the last increasing rapidly near the aperture; the glossy surface and the indented lines also serve to distinguish it from *Z. arboreus.*

FAMILY ENDODONTIDAE

GENUS *Anguispira* Morse

Anguispira alternata alternata (Say)

(Plate XXXII, Fig. 27, Cat. No. 931)

Baker, 1939, pp. 84-85.
MacMillan, 1940, pp. 380-381.

Anguispira alternata alternata is one of the most conspicuously marked shells of this region. The shell is relatively large, one-half to three-fourths inch in diameter, the suture well impressed, whorls five or slightly more, the last increasing rather rapidly near the high, rounded aperture which extends obliquely downward. The outer margin of the simple, thin lip is only slightly above the middle of the periphery; the inner margin is slightly reflected over the round, deep umbilicus. The periphery of the body whorl is rounded, though carinate in immature shells. The surface is sculptured with numerous, strong, obliquely transverse lines, which are quite apparent without magnification. The ground color of the shell is yellowish to light brown, embellished with irregular dashes of reddish-brown, especially on the upper surface, which gives this snail its common name, "tiger snail."

Occurrence. This beautiful snail has a distinct preference for woodlands, where it occupies a variety of habitats. It may be found in colonies around old stumps, among dead leaves, under logs, and moving about on moist rocky ledges where these are available. Jones (1935) has reported observations upon the interesting manner in which *Anguispira alternata* prepares for hibernation.

Height	Greater Diameter	Lesser Diameter
10.8 mm.	17.5 mm.	16.1 mm.
10.1	17.0	16.0
10.0	16.9	15.9

GENUS *Helicodiscus* Morse

Helicodiscus parallelus (Say)

(Plate XXXI, Fig. 19, Cat. No. 932)

Baker, 1939, pp. 88-89.

The shell of this snail is greenish-white, small, scarcely over one eighth inch in diameter, the four whorls coiled in a close, flat, spire

above and below, so that there is scarcely any spire, and no true umbilicus. The last whorl is scarcely increased in size and terminates in a thin lip, the outer termination of which is placed high on the body whorl, the inner low on the penultimate whorl, and somewhat reflected upward. The lunate aperture is frequently guarded by 1-3 minute denticles placed within the peristome upon the outer lip. However, many of the local specimens are edentulous. *Helicodiscus parallelus* obtains its name from the presence of distinct, rather numerous raised lines which appear on the whorls parallel to the suture. These are scarcely visible without magnification, but the species may be recognized in the field by its flattened shape, and closely coiled whorls.

Occurrence. *Helicodiscus parallelus* is primarily a woodland snail, where it lives among forest debris of various sorts, but it has been found in Kansas as far west as Meade county. Even in western Kansas, however, it is invariably found in the sparse growths of trees.

Height	Greater Diameter	Lesser Diameter
1.7 mm.	3.6 mm.	3.1 mm.
1.4	3.1	3.0
1.3	2.8	2.7

FAMILY PUPILLIDAE

GENUS *Gastrocopta* Wollaston

Gastrocopta armifera armifera (Say)

(Plate XXXII, Figs. 38, 39; Cat. No. 933)

Baker, 1939, pp. 95-97.

The cylindrical shell of *Gastrocopta armifera armifera* becomes obtusely conic toward the spire. It is the largest of the *Gastrocopta* in the local fauna. The opaque, white, paraffinelike shell is glossy and marked with fine growth lines. The moderately convex whorls, usually 6-6½ in number, are separated by well-defined, shallow sutures. The whorls increase steadily in size from the embryonic whorl to the body whorl. Toward the aperture the latter narrows considerably and sharply along the base making the aperture subtriangular. The slightly reflected, thin, sharp, peristome extends over the body whorl as a thin callus. The umbilicus is well defined but shallow. The angular and parietal lamellae are fused into a single bifed lamella extending within the aperture. The parietal is represented by a low callus, which curves laterally, terminating in a spur: the angular portion is heavier and higher, and closely approaches the columellar lamella. The latter is relatively heavy, subtriangular, with the apex directed laterally toward the angular. The

basal lamella is absent or feebly developed. When present it consists of a low, elongate callus, extending laterally toward the lower palatal. The lower palatal fold extends upward, increasing gradually in heaviness and height; it terminates abruptly beneath the angular. The upper palatal extends obliquely upward toward the lower palatal: it is much smaller than the latter. A small, nodose suprapalatal fold is usually present; rarely a minute interpalatal may be found.

Occurrence. This subspecies is represented by large numbers in a given locality and is widely distributed in the Wakarusa valley. These forms live on moist ground, under leaves, logs, and at the base of stumps or trees.

Height	Diameter
4.2 mm.	2.5 mm.
4.2	2.4
4.8	2.3

Gastrocopta armifera abbreviata (Sterki)

(Plate XXXII, Figs. 36, 37; Cat. No. 923)

Baker, 1939, pp. 95-97.

The somewhat glossy, milky white shell, fusiform in shape, is slightly smaller than that of *Gastrocopta armifera armifera.* The oblique growth lines are fine and slight. The shell is comparatively thin, but not fragile. The moderately convex whorls, usually 6 in number, are marked by well-defined, but shallow sutures. The whorls increase steadily in size from the embryonic to the body whorl which is sharply compressed around the axis. The aperture is subtriangular. The slightly reflected, thin, sharp peristome extends over the body whorl as a callus. The angular and parietal lamellae are fused and, except for being smaller, resemble that of *G. a. armifera.* The columellar lamella is somewhat smaller and more angular than that of *G. a. armifera,* however, it is practically impossible to make a definite distinction between the two subspecies. The basal lamella, always present and more developed than in *G. a. armifera,* is a triangular callus with the apex slightly reflected toward the lower palatal fold. The lower and upper palatals resemble those of *G. a. armifera.* A small nodose suprapalatal fold is usually present.

The characteristics distinguishing the subspecies *G. a. armifera* and *G. a. abbreviata* do not appear consistently. At times when the columellar lamella is rounded as described for *G. a. armifera,* a small basal fold which compares with the smaller of *G. a. abbreviata* also appears. When a basal fold is absent in a specimen of supposed

G. a. armifera, the columellar lamella very closely resembles the description of the one for *G. a. abbreviata.*

Occurrence. In this area *G. a. abbreviata* and *G. a. armifera* occur together in woodlands where they prefer living under old logs, bark, and other forest debris.

Height	Diameter
4.9 mm.	2.5 mm.
4.7	2.4
4.6	2.3

Gastrocopta contracta contracta (Say)

(Plate XXXII, Figs. 34, 35; Cat. No. 935)

Baker, 1939, pp. 97-99.

The 5½ strongly convex whorls, separated by a deep suture, increase steadily in size from the embryonic to the body whorl. The last half of the body whorl is straightened and pinched to form an elongate, narrow base. The triangular aperture, practically closed by the lamellae and folds, is surrounded by a very slightly reflected, sharp-edged lip. Behind the peristome, on the right-hand side, is a prominent, rounded ridge with a depression along either side and one over the lower palatal fold. The umbilicus is distinct. The parietal and angular lamellae are completely fused into a narrow callus extending deeply within the aperture. As it extends backward from the margin of the peristome, it greatly increases in height. About midway the lamella makes a sharp bend to the right, falls off abruptly, bends inward, and extends as a low callus for a short distance. The long, thin, high, ridgelike, subvertical columella curves outward at the top and backward at the base. The peristome is thickened by a subvertical, well-marked callus just in front of the columellar lamella. The elongate, ridgelike lower palatal fold is transversely and deeply placed on a callus which connects with the small, nodose upper palatal located farther forward. The distinguishing features are the shape of the fused parietal and angular lamellae.

Occurrence. The subspecies is fairly well represented throughout the Wakarusa valley, where it lives in moist earth under old stumps and logs, and in deep grass.

Gastrocopta pentodon (Say)

(Plate XXXII, Fig. 33, Cat. No. 936)

Baker, 1939, p. 100.
Pilsbry, 1918, Vol. 24, pp. 28-33.

The shell of *Gastrocopta pentodon* is minute, never much more than 2.0 mm. in height, and frequently in local collections, specimens

of no more than 1.4 mm. in height were found. The five whorls of the elongate-conic shell are convex, separated by a rather deep suture, body whorl large, occupying almost half the total length. Near the aperture the body whorl narrows abruptly and winds sharply around the axis, thereby reducing the umbilicus to a small shallow chink. The aperture is subtriangular or rounded below, the lip generally thin, the terminations approaching but connected by a thin wash of callus, if at all. Typically, there are about seven denticles; a fused angulo-parietal, which is high, straight, and entering deeply into the aperture; the columellar, a simple peglike denticle when viewed from the front; a small, almost nodose basal fold; a minute infrapalatal; an elongate, deeply immersed lower palatal; a small interpalatal; and a very small, but generally distinct suprapalatal. All of the denticles on the peristome are set deeply within the aperture, and placed on a thickened, whitish callus, which appears as a strong, rounded ridge below the peristome.

The denticles of *Gastrocopta pentodon* are variable in shape and appearance. The angulo-parietal in local examples is often incompletely fused, the parietal projecting off the tooth as a spur. The secondary denticles, such as the infrapalatal, the interpalatal, and the suprapalatal, are inconstant, and one or all of them may be absent. In fact, variation in many characters of the shell, such as size, shape, convexity of whorls, position of callus on which the denticles are placed, and the thickness of the lip is the rule in the collections from the Wakarusa valley. The result is that many individuals closely resemble described species or subspecies; forms almost identical with *G. tappaniana, G. curta, G. pilsbryana*, and *G. carnegiei* are frequently encountered, but since these apparent species or subspecies can be associated in a graded series, and since there seems to be no ecological nor other barrier which separates a particular type from the others, it seems logical to conclude that all are variations from the notably unstable *G. pentodon*. The taxonomic value, if any, of these variations, can finally be established only by anatomical studies on the animals themselves.

Occurrence. Hanna reported *Gastrocopta pentodon* common on Blue Mound (station No. 9) but it was found only in drift at station No. 1 during these collections. Downstream, *G. contracta* seems most successful, and perhaps has replaced *G. pentodon* in its ecological position.

Height	Diameter
2.0 mm.	1.3 mm.
1.9	1.1
1.6	0.9

Gastrocopta procera duplicata (Sterki)

(Plate XXXII, Fig. 31, Cat. No. 937)

Baker, 1929, p. 102.
Pilsbry, 1918, pp. 65-66.

The shell of *Gastrocopta procera duplicata* is elongate conic, the spire somewhat obtuse, the total length scarcely an eighth of an inch. The color is a light cinnamon brown, the surface, somewhat glossy, and etched with oblique, irregular, growth lines. The 5-6 convex whorls, separated by a distinct and rather deep suture, increase steadily in size from the paler embryonic whorls to the body whorl. The aperture is subtriangular, the peristome thin and sharp, although a rather heavy callus parallels the rim above the edge of the lip. The lip is reflected backward. The angular and parietal lamellae are fused into a single bifed plica, which is curved to form a sigmoid flexure. The columellar fold is horizontally placed, and followed below by a nodose subcolumellar denticle. The low, nodose, basal fold is located below the elongate, transverse, lower palatal which is deeply immersed. The subtriangular, upper palatal fold is also situated deeply within the aperture, but it is only about one-half as large as the lower palatal.

Gastrocopta duplicata may be distinguished from *A. mcclungi,* a similar subspecies, by the fact that in the former the lip is thin and sharp, but broad and thick in the latter.

Occurrence. Not common in this locality. It lives among grasses, in drift, and other close cover.

Height	Diameter
3.1 mm.	1.25 mm.
2.75	1.2
2.6	1.25

Gastrocopta procera mcclungi (Hanna and Johnston)

(Plate XXXII, Fig. 32, Cat. No. 938)

Baker, 1939, p. 102.
Pilsbry, 1918, pp. 66-68.

The elongate, conic shell of this tiny snail is a light cinnamon brown in color, and scarcely an eighth of an inch in length. The 5-6 convex whorls, separated by a deep suture, increase steadily in size from the lightly colored embryonic whorls to the body whorl. The wide, reflected lip is rounded by a heavy callus located at the edge of, and not within, the aperture, as in *Gastrocopta procera duplicata.* The angular and parietal lamellae are fused into a bifed sigmoid lamella; the angular portion approaches, but does not fuse with the margin of the peristome. Below the horizontally placed columellar lamella is a small, nodose, subcolumellar fold. The basal

fold is small and placed below the long, narrow transverse lower palatal which is deep within the throat. The upper palatal is smaller than the lower, and directed toward it. Directly below the peristome on the right side is a depression followed by a callus ridge. Typically there is a depression over the palatal folds.

The characteristic distinguishing this subspecies from *Gastrocopta p. duplicata,* to which it is similar in most respects, is the wide, reflected lip, which is thickened by the callus along the edge.

Occurrence. Gastrocopta procera mcclungi is not common here, this being the eastern boundary of its range, so far as known. It was discovered only in drift piles in western Shawnee county. Although *G. p. duplicata* is typically eastern in range, while *G. p. mcclungi* seems confined primarily to western, semiarid regions, in this locality the two forms intergrade completely, making it difficult to assign many specimens to either subspecies. Breeding experiments should clarify the status of these two forms.

Height	Diameter
3.2 mm.	1.3 mm.
3.1	1.2
2.6	1.1

GENUS *Vertigo* Draparnaud

Vertigo ovata (Say)

(Plate XXXII, Fig. 28, Cat. No. 939)

Baker, 1939, p. 105.
Pilsbry, 1920, Vol. 25, pp. 82-86.

The shell of *Vertigo ovata,* about 2 mm. in height, is shining, amber-colored, with five inflated whorls separated by a relatively shallow suture. The spire is bluntly conical, the body whorl considerably inflated giving the shell a ventricose form. Near the aperture the last whorl is pinched in on either side reducing the base to a rounded ridge. The lip is thin, rather deeply indented over the upper palatal fold. Within the aperture are 6 primary teeth: a small parietal; an elongate angular, rather deeply entering; a strong, horizontal columellar; a small, almost nodose basal; a strong, deeply entering lower palatal; and a thin, high, upper palatal placed directly opposite the indentation in the lip. All the teeth of the peristome are set on a thickened callus which appears as a broad ridge below the peristome. In addition to the primary teeth, secondary, usually minute, denticles, such as an infraparietal, infrapalatal, and suprapalatal frequently appear.

Occurrence. This tiny *Vertigo* which lives in moist situations is rarely found in the Wakarusa valley.

Height	Diameter
2.25 mm.	1.4 mm.

Vertigo tridentata Wolf

(Plate XXXII, Fig. 29, Cat. No. 940)

Pilsbry, 1919, Vol. 25, pp. 106-107.
Hanna, 1909, p. 3.

The 5 whorls of this ovate to oblong, light-amber colored shell are moderately convex, separated by a well-impressed suture and delicately sculptured with obliquely vertical striations, except for the embryonic whorls which have a white, waxy texture. The last whorl, which turns abruptly reducing the umbilicus to a small chink, is sharply constricted below the aperture to a subtriangular form with a depression below the lower palatal tooth. The aperture is subtriangular, the lip thin and simple, except for the sharp indentation on the outer wall. Typically there are three denticles: a simple, somewhat elevated parietal; a nodose columellar; and a low, triangular, lower palatal fold; and not infrequently, there is a weakly-developed upper palatal fold as well. The denticles on the peristome are rather deeply immersed and set on a rather heavy white callus which is produced as an external ridge behind the peristome. The terminations of the lip are connected by a thin callus.

Occurrence. Although Hanna remarked that this species is, "our commonest *Vertigo*," it now seems to be extremely rare. Only two specimens were taken from drift, station 1.

Height	Diameter
2.1 mm.	1.2 mm.
1.9	1.1

GENUS *Pupoides* Pfeiffer

Pupoides marginatus (Say)

(Plate XXXII, Fig. 30, Cat. No. 941)

Baker, 1939, pp. 108-109.

The light amber to light brown colored shell of this species is about one-fourth inch in length. The 6 convex whorls, separated by a deeply impressed suture, increase only slightly in size from the embryonic toward the body whorl. The latter becomes slightly compressed toward the aperture. The somewhat glossy surface is covered with fine, oblique growth lines. The umbilicus is small in diameter, but deep. There are no folds or lamellae within the aperture, a rather unusual condition among pupillid snails. The lip of the peristome is broadly reflected, light in color, and thickened by a heavy callus. The left termination of the lip is slightly recurved, the right termination more so, but the ends are not continuous, although connected by a thin callus.

This pupillid can be recognized by its size, broadly reflected lip, shape, and the lack of folds or lamellae within the aperture.

Occurrence. Not numerous in this locality, but more widely distributed than the single record indicates. Lives either in woodlands, or in deep grass or other vegetation.

Height	Diameter
5.8 mm.	2.2 mm.
5.6	2.3
5.1	2.1

FAMILY STROBILOPSIDAE

GENUS *Strobilops* Pilsbry

Strobilops labyrinthica (Say)

(Plate XXXI, Figs. 22, 23, 24, Cat. No. 942)

Baker, 1939, pp. 111-112.
Pilsbry, 1935, pp. 20-22.

The small, cinnamon-brown shell of *Strobilops labyrinthica* is low, convex-conoid with a somewhat flattened base. The inner termination of the heavy lip is partially reflected over the small, round, umbilicus. The 5½ to 6 whorls are tightly coiled, separated by distinct suture and sculptured, save for the nuclear whorls which are smooth and granular, with relatively heavy, obliquely vertical, riblets which are diminished somewhat over the base. The periphery of the body whorl is slightly angular, the peristome obliquely semilunar. One of the characteristic features of the genus *Strobilops* is a series of elongate lamellae on the parietal wall and a variable series of folds on the base deep within the aperture. In *S. labyrinthica* there are 3 lamellae; a strong, high, parietal which extends from the aperture; and interparietal not visible from the aperture; and an infraparietal which is weakly developed near the aperture and can be seen, if at all, only by peering in the opening. The interparietal is weakly developed, frequently consisting of a chain of small droplets and begins about a half whorl within the aperture. (Plate XXXI, Fig. 24.) However, all three lamellae in the local forms tend to terminate at the same distance within a single individual, but the actual extent of the 3 lamellae varies widely in different examples. In some specimens these lamellae extend through a complete revolution of a whorl, terminating above the aperture, a feature characteristic of the form which Pilsbry has called *S. parietalis* (1935). In others the lamellae extend no more than three quarters of a turn. The inconsistency in this respect together with the weak riblets on the base seems to make it desirable to refer this species

to *labyrinthica,* (Pilsbry, 1943).* The 6 basal folds, which are collectively known as the internal barrier are fairly characteristic of *labyrinthica* and are illustrated on Plate VII, Fig. 23.

Occurrence. *Strobilops labyrinthica* inhabits moist, shaded woodlands, in fact, it is confined to such situations. It is most abundant locally on Blue Mound, and at station No. 11, where these snails were found crawling about on old stumps and logs.

Height	Diameter
1.9 mm.	2.5 mm.
1.9	2.6
2.1	2.4

FAMILY VALLONIDAE

GENUS *Vallonia* Risso

Vallonia costata (Müller)

(Plate XXXII, Fig. 26, Cat. No. 943)

Baker, 1939, p. 119.

The small, heliciform shell of this snail measures about 1.2 mm. in height and about 2.5 mm. in diameter. The color is usually a milky white, but a straw to light brown is not uncommon. There are three whorls, those of the spire coiled almost in the same plane, while the body whorl angles downward near the aperture. The peristome of the ovate aperture is widely reflected, flattened, and comparatively thin and sharp. The ends of the lip approach, and are connected over the parietal wall by a thin callus. The 1½ embryonic whorls are smooth, but the remainder are characterized by regularly placed, prominent ribs, occurring about 5 per mm. of space along the whorls. The intercostal spaces are marked with fine striations. All of the whorls can be seen through the wide umbilicus.

The conspicuous ribbing and the broadly reflected peristome are the prime recognition characters of this species.

Occurrence. *Vallonia costata* is rather widely distributed, but frequently overlooked because of its small size. It lives under logs or stones, where there is considerable moisture, although it will survive arid periods. It is common around rocky ledges, and may often be found burrowing into the soil for several inches from which it may be recovered by sifting methods.

Height	Greater Diameter	Lesser Diameter
1.2 mm.	2.5 mm.	2.3 mm.
1.2	2.5	2.0
1.1	2.3	1.8

* Personal communication.

FAMILY COCHLICOPIDAE

GENUS *Cochlicopa* (Ferussac) Risso

Cochlicopa lubrica (Müller)

(Plate XXX, Fig. 1, Cat. No. 944)

Baker, 1939, p. 120.
Goodrich, 1932, pp. 24-25.
Chamberlain and Jones, 1929, pp. 90-91.

Cochlicopa lubrica has a smooth, glossy, light amber, fusiform shell with never more than six slightly convex whorls. The suture is not deeply impressed, the body whorl large, equal to the height of the spire, and terminating in an oval aperture which occupies about one third of the total length. The inner termination of the simple, thickened, and bluntly rounded lip completely seals the umbilicus and is connected with the outer lip by a distinct callus over the parietal surface. The surface is sculptured with obliquely transverse growth lines, but these are inconspicuous and do not dull the high polish which is so characteristic of this species.

Occurrence. *Cochlicopa lubrica* is not abundant in this region but may be found in small numbers in moist woodlands among dead leaves, and under bark and old logs.

Height	Diameter
5.9 mm.	2.3 mm.
5.8	2.3
5.4	2.2

FAMILY SUCCINEIDAE

GENUS *Succinea* Draparnaud

Succinea grosvenori Lea

(Plate XXX, Fig. 8, Cat. No. 945)

Chamberlain and Jones, 1929, p. 117.

Succinea grosvenori has an elongate, spiral shell of 3, or somewhat more, moderately convex, whorls which increase rapidly in size as they wind loosely around the flat, spirally descending axis. The suture is rather deeply impressed. The spire is very short, occupying less than one-fourth of the total length; the rounded oval aperture, bordered by a thin simple lip, connected by a wash of callus across the body whorl, is large, occupying at least one half of the total length. The color is light yellowish-brown, sometimes streaked with darker brown, the shell translucent, thin and fragile, the surface embellished with rather coarse, irregular growth lines.

Occurrence. The succineas are sometimes erroneously referred to as "amphibious" due to the preference of many of them for low, wet

places. The common local form, *S. grosvenori,* is no exception to this rule and while it is widely distributed in a variety of habitats, it apparently thrives best on the grass and reeds near or above the water in roadside ditches and similar situations, such as those of station No. 8. The species is widely distributed in Kansas where it succeeds well even in arid regions, due to its ability to withstand hot, dry, periods by aestivation, though it requires moist conditions during its active periods.

Height	Diameter
11.0 mm.	6.3 mm.
10.0	5.4
9.9	5.4

FAMILY LIMACIDAE

GENUS *Deroceras* Rafinesque

Deroceras gracile Rafinesque (?)

(Plate XXXII, Fig. 25, Cat. No. 946)

Baker, 1939, pp. 129-130.

Most snails have a shell which is developed sufficiently to allow the animal to withdraw completely within it, but the peculiar gastropods known as slugs have only a rudiment of the shell. *Deroceras gracile,* one of the smallest of the slugs, is rather common in the Wakarusa valley. It is about an inch long, of an almost uniform dark gray to black color, although it is said to range to light yellow in some localities. The eye peduncles are long, the tentacles are relatively short. The foot, which has 2 parallel grooves on the pedal surface, is somewhat lighter in color than the remainder of the body. The mantle, which is the rudiment of the shell, covers the anterior third or so of the body. On the right side of the mantle is a perforation, the opening to the lung cavity.

Occurrence. Deroceras gracile is widely distributed through this area in woods and about rocky ledges and slopes, but the animals are not seen about except when atmospheric humidity runs rather high. At drier times they seclude themselves under logs and stones. *D. gracile* is almost solitary in habit, for no more than one may ordinarily be found in any given place, even in a locality where the animal is common.

SPECIES OF GASTROPODA	ST.1-6 M.W. 1/2 M.S. OF AUBURN	ST.2-1/2 M.S. OF AUBURN	ST.3-3 M.E. OF WAKARUSA	ST.4-6 M.E. OF WAKARUSA	ST.5-11/2 M.E. OF WAKARUSA	ST.6-11/2 M.E. OF BELVOIR	ST.7-4 M.E. 1 M.N. OF CLINTON	ST.8-2 M.S. 1 M.E. OF CLINTON	ST.9-3 1/2 M.S. 2 M.E. OF LAWRENCE	ST.10-3 1/2 M.S. 3 M.E. OF LAWRENCE	ST.11-1/2 M. W. OF EUDORA	STATIONS AND OCCURENCE OF SPECIES
CAMPELOMA SUBSOLIDUM										O		
LYMNEA BULIMOIDES TECHELLA											O	
LYMNEA PARVA	O											
LYMNEA OBRUSSA	O											
HELISOMA TRIVOLVIS	O	O									O	
PHYSA ANATINA	O	O									O	
PHYSA HAWNII	O										O	
TRIODOPSIS ALBOLABRIS										O		
MESODON ZALETUS								O		O		O
STENOTREMA FRATERNUM FRATERNUM	O	O			O	O	O	O	O	O	O	O
RETINELLA ELEGTRINA	O				O			O		O		O
RETINELLA INDENTATA	O	O			O	O	O	O	O	O	O	O
HAWAIIA MINISCULA	O							O	O	O	O	O
EUCONULUS CHERSINUS	O									O		
ZONITOIDES ARBOREUS	O				O	O	O	O	O	O	O	O
ANGUISPIRA ALTERNATA		O			O			O	O	O		
HELIGODISCUS PARALLELUS	O	O			O				O			O
GASTROCOPTA ARMIFERA ARMIFERA	O	O			O	O			O	O	O	O
GASTROCOPTA ARMIFERA ABBREVIATA	O	O									O	O
GASTROCOPTA CONTRACTA CONTRACTA	O					O			O	O	O	O
GASTROCOPTA PENTODON	O											
GASTROCOPTA PROGERA DUPLICATA	O											
GASTROCOPTA PROGERA MCCLUNGI	O											
VERTIGO OVATA	O											
VERTIGO TRIDENTATA	O											
PUPOIDES MARGINATUS	O											
STROBILOPS LABYRINTHICA	O										O	O
VALLONIA COSTATA	O									O	O	O
COCHLICOPA LUBRICA										O	O	O
SUCCINEA GROSVENORI	O	O			O	O	O	O	O	O	O	O
DEROCERAS GRACILE	O					O					O	O
CARYCHIUM EXILE	O											

TEXT FIG. 6. Distribution of gastropod species in the Wakarusa river.

DISCUSSION

When Hanna reported upon the mollusca of Douglas county over thirty years ago (1909) he listed no less than 75 species and subspecies of gastropods, or more than twice the number included in the present report from the Wakarusa valley. There are several factors which serve to account for this difference in the variety of the reported faunas. Firstly, there seems little doubt that a number of species reported by Hanna are now extinct in this region. For example, *Triodopsis multilineata* and *Allogona profunda,* both included in the Hanna report, are large, conspicuously marked snails which could scarcely be overlooked, so it seems reasonable to conclude that the failure to find them indicates their local extinction. The same conclusion seems valid in the case of *Campeloma,* the shells of which are large and easily recognized. Hanna reported two species, *C. decisum* and *C. subsolidum,* and remarked that "these two forms live abundantly in the Wakarusa Creek," but intensive search throughout the course of the stream has failed to discover them living there today. *Amnicola* and *Bulimulus* are apparently among the genera which may now also be considered extinct in this locality.

Secondly, in addition to the extinction of forms previously living here, Hanna's list becomes reduced if limited to species actually living in the county. Many of his reported species were collected from drift along the Kansas river, and may have drifted for many miles. In fact, there is ample reason for believing that several of the species reported by Hanna are actually Pleistocene fossils weathered from the extensive deposits of the Smoky Hill terraces and other Pleistocene deposits farther west. This is likely the case with regard to the record of *Hendersonia occulta* which has never been discovered living here, though the well-preserved shells are abundant in certain Pleistocene depositions of the Smoky Hill river valley. Since the fossil shells float easily when empty of the matrix in which they are imbedded, there is no reason for believing they could not appear as drift specimens along the Kansas river here, or even farther downstream. Hanna's several species of *Pupilla* probably belong in this category, that is, fossil shells cast up in drift. It is sometimes extremely difficult to distinguish some fossil shells from bleached recent shells.

A third factor which is in part responsible for the size of the previous list is the recognition of many subspecies which do not seem well defined in this region, at least, at the present time. Of course, it must be admitted that a number of forms may have been overlooked, which will eventually be found in this area.

Eastern Kansas lies in a transitional zone, especially with regard to molluscan faunas. This is the extreme western limit of the large *Mesodon* group; none seem to live in Kansas west of the Flint Hills. Likewise, Kansas is transitional between the truly southern faunas, and those of the northern states. The result is that in many instances, exact diagnosis of local forms is difficult and unsatisfactory. In addition to these natural difficulties there are those resulting from too enthusiastic differentiation of species by authors.

As cases in point, among the local fauna may be mentioned *Physa, Succinea, Strobilops, Stenotrema, Gastrocopta, Triodopsis,* and others, which have poorly delineated species in this vicinity. For these reasons, a conservative point of view has been adopted in the preparation of the list of species presented in this report.

Although, on the authority of Dr. William Clench, two species, *Physa anatina* and *P. hawni,* have been recognized, it is possible in a large series of local shells to find many individuals which are identical with those of several additional species. On the other hand, *Physa anatina* and *P. hawni* may be found living together in the same small pool, and it is not difficult to find "intermediate" shells, which places the validity of these species in doubt. *Physa* is notable for its tendency toward variation, and a full understanding of speciation in the genus awaits the outcome of thoughtful experimentation and careful observation.

The same general difficulty is encountered with *Succinea.* Certain individuals, for instance, among the local collections are identical with *S. avara,* others with *S. concordalis.* The fact that there is little or no segregation from the prevalent *S. grosvenori* on the basis of ecological selection makes it seem almost certain that *Succinea grosvenori* is the only true species represented locally.

In the same manner, *Strobilops* is unstable locally. Many forms tend toward the southeastern *S. labyrinthica parietalis,* and others toward the southwestern *S. texasiana,* but Pilsbry (personal communication) is of the opinion that *S. labyrinthica* is the only appropriate name to attach to local specimens. Similar problems encountered among *Stenotrema, Gastrocopta armifera, G. pentodon,* and *Triodopsis* serve to emphasize the fact that in this transitional zone the mingling of eastern and western, northern and southern, forms makes systematic work extremely difficult. However, it seems not unlikely that the conditions prevailing here may make it possible in time to solve many of the perplexing problems of taxonomy among the mollusks. More attention must be paid to the details of environ-

ment in future studies, and less attention focused on the naming of new forms unless they represent well-defined species, or subspecies of a geographical or ecological nature.

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PLATE XXVIII

FIG. 1. *Lampsilis siliquoidea* (Barnes).
"Fat Mucket."
x ⅓.

FIG. 2. *Anodonta grandis* Say.
"Floater."
x ⅓.

FIG. 3. *Truncilla donaciformis* (Lea).
"Fawn's Foot."
x ½.

FIG. 4. *Carunculina parva* (Barnes).
"Liliput Shell."
x 1⅓.

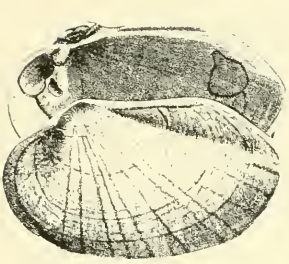
FIG. 5. *Quadrula pustulosa* (Lea).
"Pimple Back."
x ⅔.

FIG. 6. *Leptodea fragilis* (Rafinesque).
"Fragile Paper Shell."
x ⅓.

FIG. 7. *Tritogonia verrucosa* (Rafinesque).
"Buckhorn."
x ⅓.

FIG. 8. *Quadrula quadrula* (Rafinesque).
"Maple Leaf."
x ⅔.

PLATE XXVIII



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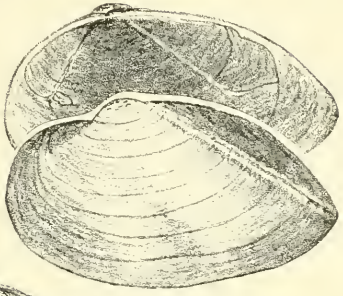

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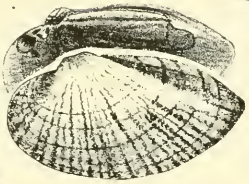

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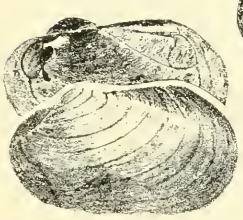

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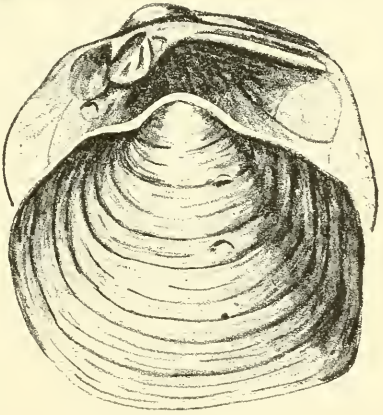

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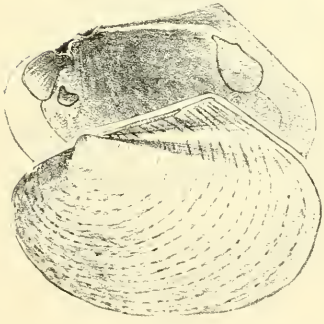

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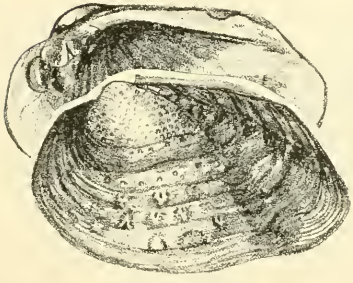

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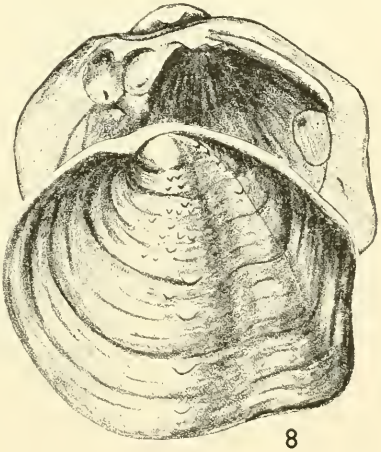

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PLATE XXIX

FIG. 9. *Strophitus rugosus* (Swainson).
"Squaw Foot."
x ⅔.

FIG. 10. *Ligumia subrostrata* (Say).
x ⅔.

FIG. 11. *Uniomerus tetralasmus* (Say).
x ⅓.

FIG. 12. *Lampsilis anodontoides* (Lea).
"Yellow Sand Shell."
x ⅓.

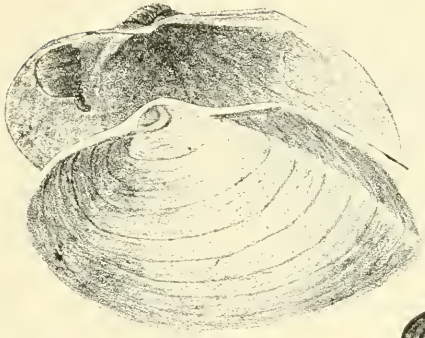
FIG. 13. *Lasmigona complanata* (Barnes).
"White Heel Splitter."
x ⅓.

FIG. 14. *Amblema costata* (Rafinesque).
"Three-Ridge."
x ⅓.

FIG. 15. *Fusconaia flava* (Lea).
"Wabash Pig Toe."
x ⅔.

FIG. 16. *Proptera alata* (Say).
"Pink Heel Splitter."
x ⅓.

PLATE XXIX



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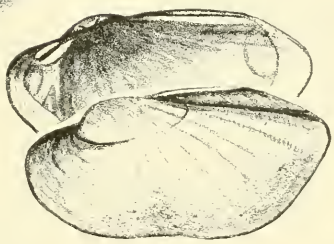

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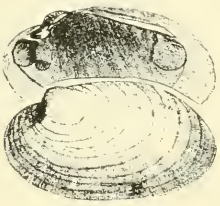

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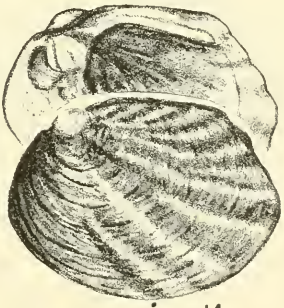

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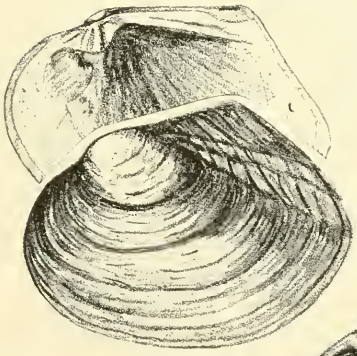

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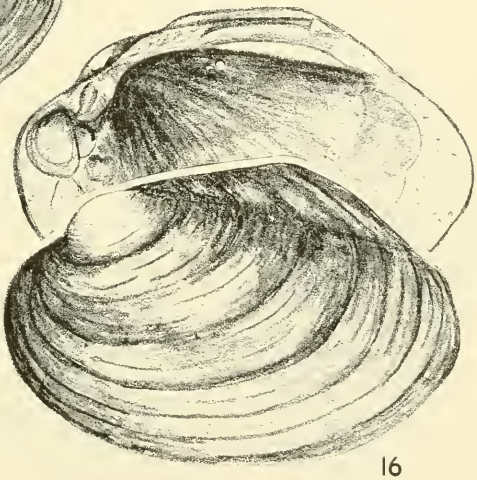

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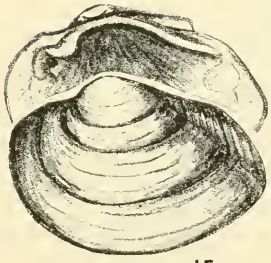

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PLATE XXX

FIG. 1. *Coehlicopa lubrica* (Müller).
x 10.5.

FIG. 2. *Helisoma trivolvis* (Say).
x 5.

FIG. 3. *Carychium exile* H. C. Lea.
x 10.5.

FIG. 4. *Carychium exile* H. C. Lea.
Dissected view.

FIG. 5. *Lymnaea bulimoides techella* (Haldeman).
x 5.

FIG. 6. *Lymnaea parva* Lea.
x 5.

FIG. 7. *Lymnaea obrussa* Say.
x 5.

FIG. 8. *Succinea grosvenori* Lea.
x 3.5.

FIG. 9. *Campeloma subsolidum* Anthony.
x 5.

FIG. 10. *Physa anatina* Lea.
x 5.

FIG. 11. *Physa hawni* Lea.
x 5.

PLATE XXX

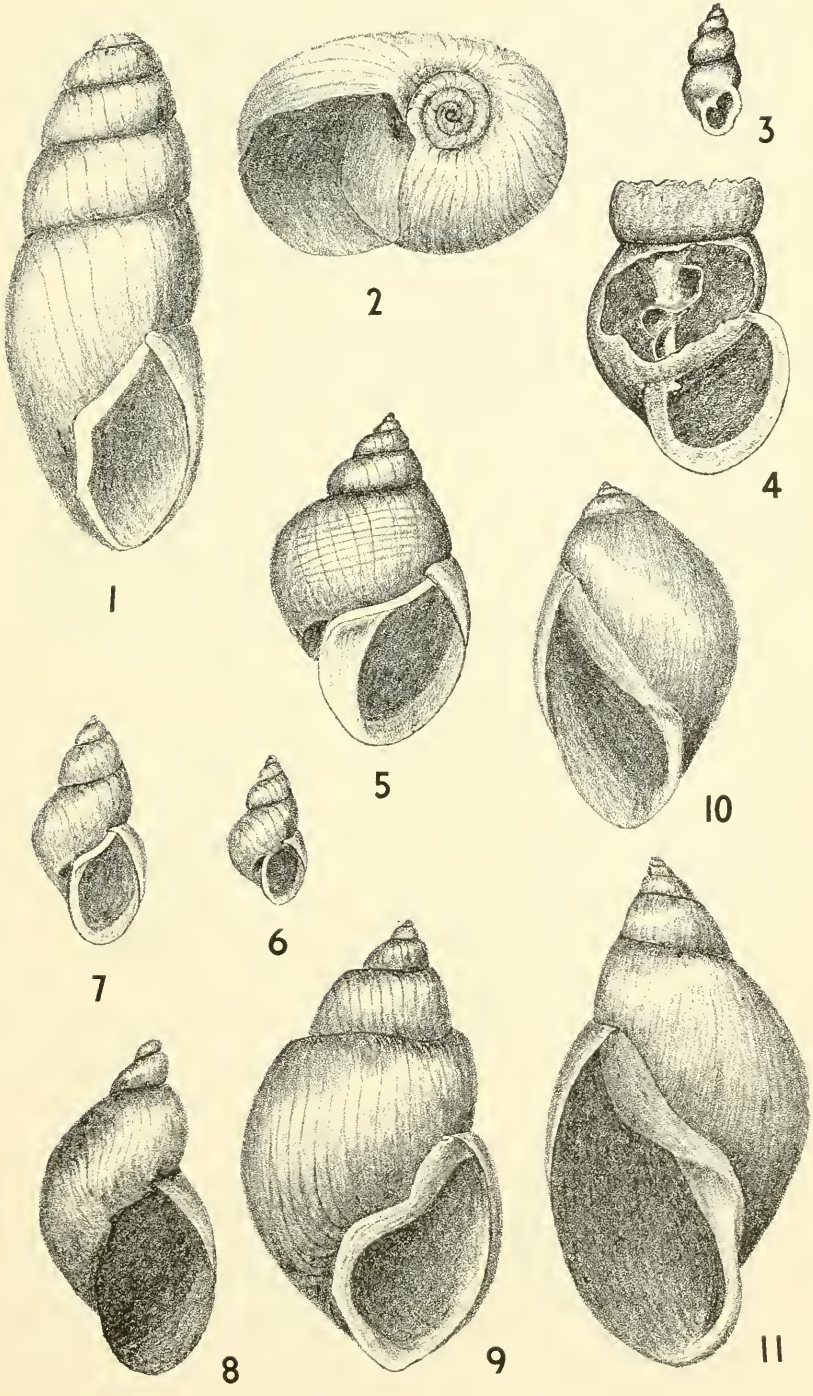


PLATE XXXI

FIG. 12. *Retinella electrina* (Gould).
x 10.5.

FIGS. 13 and 17. *Triodopsis albolabris alleni* ('Wetherby' Sampson).
x 1.7.

FIG. 14. *Retinella indentata* (Say).
x 10.5.

FIG. 15. *Zonitoides arboreus* (Say).
Umbilical view.
x 10.5.

FIG. 16. *Euconulus chersinus* cf. *polygyratus* (Pilsbry).
x 10.5.

FIG. 18. *Stenotrema fraternum fraternum* (Say).
Umbilical view.
x 3.5.

FIG. 19. *Helicodiscus parallelus* (Say).
Umbilical view.

FIG. 20. *Hawaiia miniscula* (Binney).
Lateral view.
x 10.5.

FIG. 21. *Hawaiia miniscula* (Binney).
Spiral view.
x 10.5.

FIG. 22. *Strobilops labyrinthica* (Say).
External view.
x 10.5.

FIG. 23. *Strobilops labyrinthica* (Say).
Showing basal folds.
x 10.5.

FIG. 24. *Strobilops labyrinthica* (Say).
Showing parietal, interparietal, and infraparietal lamellae.
x 10.5.

PLATE XXXI

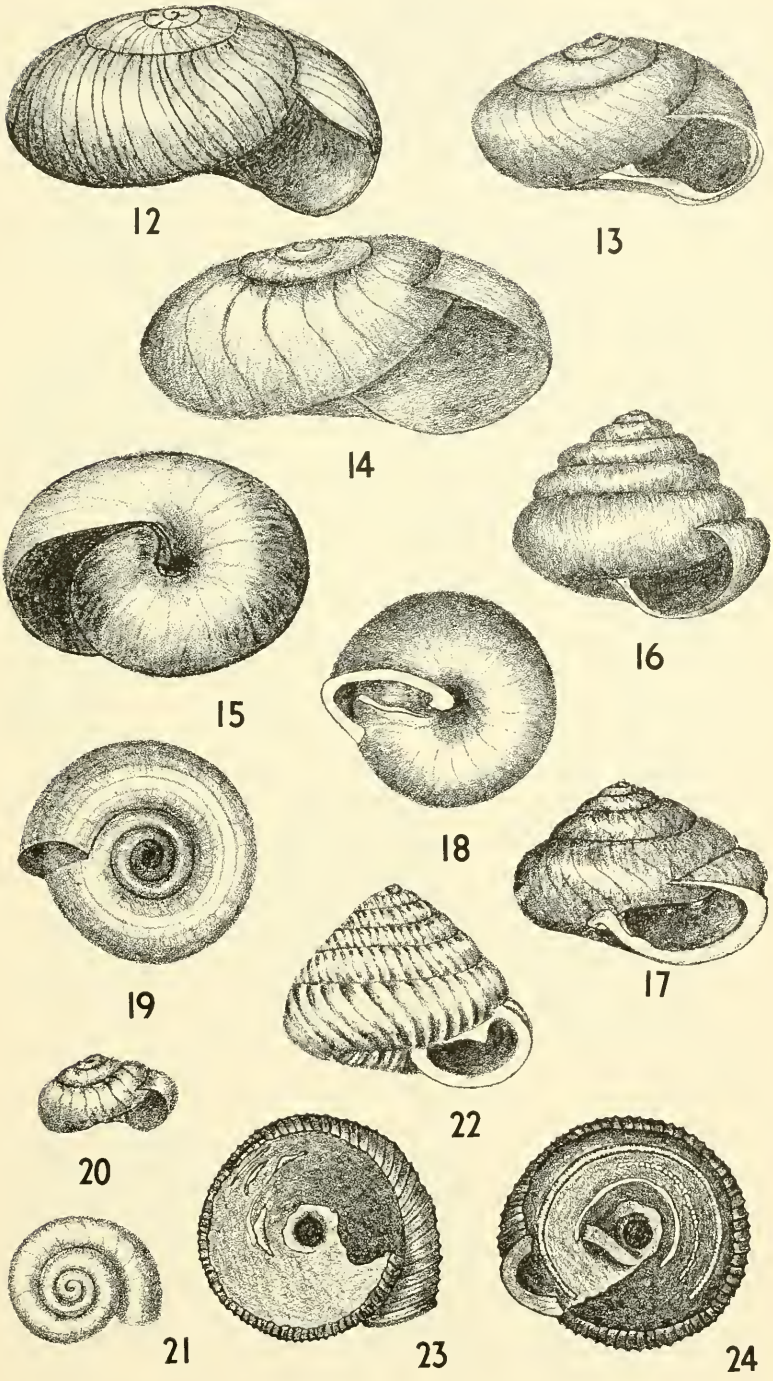


PLATE XXXII

FIG. 25. *Deroceras gracile* Rafinesque ?.
x 4.6.

FIG. 26. *Vallonia costata* (Müller).
Umbilical view.
x 10.5.

FIG. 27. *Anguispira alternata alternata* (Say).
x 1.7.

FIG. 28. *Vertigo ovata* Say.
x 10.5.

FIG. 29. *Vertigo tridentata* Wolf.
x 10.5.

FIG. 30. *Pupoides marginatus* (Say).
x 10.5.

FIG. 31. *Gastrocopta procera duplicata* (Sterki).
x 10.5.

FIG. 32. *Gastrocopta procera mcclungi* (Hanna and Johnston).
x 10.5.

FIG. 33. *Gastrocopta pentodon* (Say).
x 10.5.

FIG. 34. *Gastrocopta contracta contracta* (Say).
x 10.5.

FIG. 35. *Gastrocopta contracta contracta* (Say).
Dissected view.

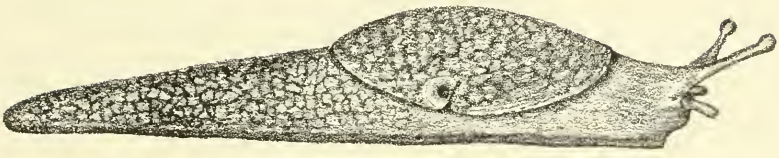
FIG. 36. *Gastrocopta armifera abbreviata* (Sterki).
x 10.5.

FIG. 37. *Gastrocopta armifera abbreviata* (Sterki).
Dissected view.

FIG. 38. *Gastrocopta armifera armifera* (Say).
x 10.5.

FIG. 39. *Gastrocopta armifera armifera* (Say).
Dissected view.

PLATE XXXII



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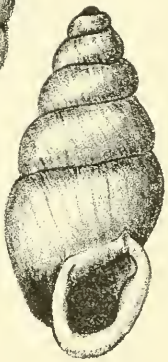

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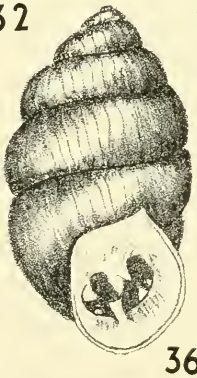

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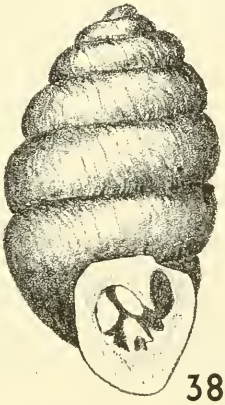

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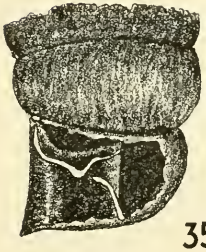

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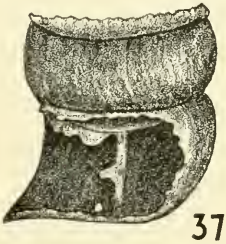

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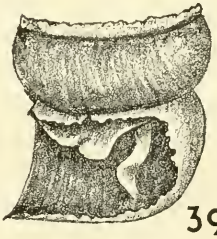

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III.....Nos. 1-6, weight, 33 ounces. Nos. 7-10, weight, 25 ounces.

IV.....Nos. 1-6, weight, 33 ounces. Nos. 7-20, weight, 28 ounces.

V.....Nos. 1-11, weight, 33 ounces. Nos. 12-21, weight, 27 ounces.

VI.....No. 1, weight, 27 ounces. Nos. 2-7, weight, 19 ounces.

VII.....Nos. 1-17, weight, 50 ounces.

VIII.....Nos. 1-10, weight, 52 ounces.

IX.....Nos. 1-21, weight, 54 ounces.

X.....Nos. 1-15, weight, 17 ounces.

XI.....No. 1, weight, 20 ounces.

XII.....Nos. 1-2, weight, 19 ounces.

XIII.....Pt. I, Nos. 1-9, weight, 12 ounces. Pt. II, Nos. 10-15, weight, 10 ounces.

XIV.....Nos. 1-21, weight, 34 ounces.

XV.....Nos. 1-6, weight, 18 ounces.

XVI.....Nos. 1-6, weight, 14 ounces.

XVII.....Pt. I, No. 1, weight, 18 ounces. Pt. II, Nos. 2-7, weight, 8 ounces.

XVIII.....Nos. 1-13, weight, 38 ounces.

XIX.....Pt. I, Nos. 1-7, weight, 6 ounces. Pt. II, Nos. 8-14, weight, 16 ounces.

XX.....Pt. I, Nos. 1-6, weight, 11 ounces. Pt. II, Nos. 7-21, weight, 15 ounces

XXI.....Nos. 1-16, weight, 32 ounces.

XXII.....Nos. 1-18, weight, 32 ounces.

XXIII.....No. 1, weight, 40 ounces.

XXIV.....Nos. 1-21, weight, 38 ounces.

XXV.....Nos. 1-22, weight, 43 ounces.

XXVI.....Nos. 1-15, weight, 40 ounces.

XXVII.....Pt. I, weight, 20 ounces.

XXVIII.....Pt. I, weight, 20 ounces. Pt. II, 20 ounces.

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Date Due